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GENETIC PSYCHOLOGY

KEY TO PRONUNCIATION.

ā̈	far, father
ā	fate, hate
a or ă	at, fat
ẫ	air, care
ạ	ado, sofa
â	all, fall
ch	choose, church
ē	eel, we
e or ĕ	bed, end
ė	her, over: also Fr. *e*, as in *de; eu*, as in *neuf;* and *oeu*, as in *boeuf, coeur;* Ger. *ö* (or *oe*), as in *ökonomie.*
ẹ	befall, elope
ē̈	agent, trident
ff	off, trough
g	gas, get
gw	anguish, guava
h	hat, hot
h or H	Ger. *ch*, as in *nicht, wacht*
hw	what
ī	file, ice
i or ĭ	him, it
ï	between e and i, mostly in Oriental final syllables, as, Ferid-ud-din
j	gem, genius
kw	quaint, quite
ṅ	Fr. nasal *m* or *n*, as in *embonpoint, Jean, temps*
ñ	Span. *ñ*, as in *cañon* (căn′yŏn), *piñon* (pēn′yŏn)
ng	mingle, singing
nk	bank, ink
ō	no, open
o or ŏ	not, on
ô	corn, nor
ȯ	atom, symbol
ọ	book, look
oi	oil, soil; also Ger. *eu*, as in *beutel*
ö or oo	fool, rule
ou or ow	allow, bowsprit
s	satisfy, sauce
sh	show, sure
th	thick, thin
ŧh	father, thither
ū	mute, use
u or ŭ	but, us
u̇	pull, put
ü	between u and e, as in Fr. *sur*, Ger. *Müller*
v	of, very
y	(consonantal) yes, young
z	pleasant, rose
zh	azure, pleasure
′(prime), ″ (secondary)	accents, to indicate syllabic stress

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F

FRANCO, frän'kō, **Giovanni Battista**, Italian painter and etcher, called Il Semolei: b. Udine, 1510; d. Venice, 1580. He visited Rome, where his Venetian manner was much influenced by that of Michelangelo. His best work was done in decorative lines. Upon the victorious entry of Charles V of Spain into Rome in 1536 he embellished the triumphal arch with scenes descriptive of the city's history. His principal canvas is a 'Baptism of Christ' in the Venetian Church of San Francesco della Vigna. His etchings, including such plates as 'The Adoration of the Shepherds' and 'The Scourging of Christ' (after Titian), are by many preferred to his paintings, which are criticized for defects of color.

FRANCO-GERMAN or FRANCO-PRUSSIAN WAR, the stupendous conflict between France and Germany in 1870–71, which resulted in the total defeat of the French, the overthrow of the Napoleonic dynasty, the establishment of the Third Republic in France and the consolidation of Germany into an empire under the leadership of Prussia.

The remote causes of this war are to be sought in the jealousy which had long existed between France and Prussia, and which was strengthened on the side of France by the Prussian defeat of Austria in 1866, which secured to her rival the unquestioned leadership in Germany. The immediate occasion of the war occurred in June 1870, when General Prim, commanding in Spain after the deposition and abdication of Queen Isabella, offered the crown of that country to Leopold of Hohenzollern, a prince belonging to the reigning house of Prussia. It was thought in France that the acceptance of this offer would endanger the balance of power in Europe, and more particularly would threaten the safety of France, by putting Prussia in a position to attack it both in the east and in the south. Accordingly, the government of Napoleon III demanded of the King of Prussia that he should forbid the candidature of the prince. The prince voluntarily retired from his candidature, but the French ambassador offensively insisted that this renunciation should be formally made by the king and a guarantee given that the candidature would not be revived. This demand was refused and a formal declaration of war by France against Prussia was received by Count Bismarck, the chancellor of the North German Confederation, on the 19th of July. The war was welcomed by both sides with equal enthusiasm. While the French were the first in getting their troops to the frontier it soon became manifest that instead of being in a complete state of readiness, as the Minister of War had declared, the army was defective in almost everything essential to its equipment.

In contrast to this the arrangements for mobilizing the German army, which had previously been tested in Prussia in 1864 and 1866, were again found to work admirably. Each section of the army was completely organized in the headquarters of the district which it occupied in time of peace and was only sent to the frontiers after being furnished with everything it required. In addition to this, Prussia, against which country alone the war had been declared, was not only joined according to treaty by all the states of the North German Confederation but also by those of the south, upon whose neutrality, perhaps even upon whose alliance, Napoleon and the French had counted. The whole of Germany north and south was thus in arms and was able to muster forces far outnumbering those of the French. While the whole French army brought into the field at the commencement of the war numbered no more than 310,000 men, the troops of the Germans in the field amounted in all to 477,000, to which must be added strong reserves ready, with the exception of such as were necessary to protect the interior and to resist a threatened landing on the north coast by the French fleet, to be brought to the scene of war at any time, giving a total strength on the side of the Germans of more than 1,000,000 men.

The German forces were divided into three armies; the First Army had its headquarters at Trèves under General Steinmetz; the Second Army occupied the Bavarian Palatinate under Prince Frederick Charles; while the Third Army, under the crown prince of Prussia, was stationed in northern Baden. The cavalry of each army, instead of being attached in separate divisions to each of the corps d'armée composing the army, were in this way massed together into one body, and in this formation rendered very important services during the war. The commander-in-chief of the whole forces was King William of Prussia, who was supported by a staff of general officers, with Von Moltke at their head. The French army, under Napoleon himself, had its headquarters at Metz, and two advanced divisions were stationed on the borders of France and Germany, the one in the north on the Saar, under General Frossard, the other farther south at Weissenburg, under General Douay. The first overt act of war took place on 2 August, in which a part of the northern division of the French army, in the presence of Napoleon and the prince imperial, compelled a few Prussian troops belonging to the First Army, after some hours' firing, to evacuate Saarbrücken. After this Von Moltke assumed the offensive. His plan was to unite the three armies in the line of the Moselle in order to attack the enemy's centre with the view of obtaining the shortest line of operations in the direction of Paris, and in this he was completely successful. On 4 August the army under the crown prince defeated the advanced southern division of the French army at Weissenburg, and on 6 August MacMahon's army at Wörth; on the latter date also the first and second German armies had routed the northern division of the French army at Forbach, with terrible loss on both sides. In two separate armies, commanded respectively by Marshal Bazaine and Marshal MacMahon, the French retreated. To prevent their union Steinmetz and Frederick Charles pursued Bazaine, defeated him at Courcelles on 14 August, at Mars-la-Tour on the 16th, at Gravelotte with awful slaughter on the 18th, and shut him up in Metz. The crown prince and his army following MacMahon advanced to Nancy; there reinforced by a newly formed army under the crown price of Saxony, they advanced on Châlons, where MacMahon's army had been reorganized and strengthened, and was expected to retreat on Paris. Following instructions, however, MacMahon moved northward to make a descent upon Metz and relieve Bazaine. He was overtaken near Beaumont, and on 27 August and on the days immediately succeeding a number of engagements and strategic movements resulted in MacMahon's army being surrounded at Sedan on 1 September by a force of overwhelming numbers. On the following day both army and fortress were forced to capitulate. Forty generals, 4,000 officers of all grades and 84,000 soldiers became prisoners of war. Among the prisoners was Napoleon III, who was unexpectedly found to have been present with the army of MacMahon. On the day after the battle he had a personal interview with King William of Prussia, who assigned to him Wilhelmshöhe, near Cassel, as a place of residence during his captivity.

At the news of this disastrous defeat the Parisians in an outburst of rage demanded the dethronement of the Napoleon dynasty, and on 4 September a republic was proclaimed. A government of national defense presided over by General Trochu, military governor of Paris, was formed, but before any effective measures could be adopted Paris was invested by the Germans on 19 September. A day or two before a delegation from the central government had escaped from Paris and established themselves at Tours, where they were joined on 9 October by Gambetta, who escaped from Paris by balloon. It was some time before the French were able to organize a new army, and in the meantime, 27 September, Strassburg fell into German hands, and on 28 October Metz, which had been invested by the second German army under Prince Frederick Charles, capitulated. By the beginning of November war in the open field had been resumed at various points: in the north, in the southeast and on the Loire in the neighborhood of Orleans. The army of the Loire, under Gen. Aurelle de Paladines, compelled the Germans to evacuate Orleans on 7 November, but was unable to follow up this temporary success, and on 4 December and on 12 January was severely defeated by Prince Frederick Charles. The army of the north, under General Faidherbe, which had been hastily formed to attempt the relief of Paris, after many gallant attempts which were checked by the first German army under General Manteuffel, was finally defeated at Saint Quentin on 19 January. In the east and southeast the results were equally disastrous to the French. General Werder defeated the French troops under Cambriels in the Vosges, the irregular forces under Garibaldi in Burgundy, and at Héricourt on the Lisaine on 15, 16 and 17 January kept in check the army of Bourbaki until the approach of Manteuffel compelled Bourbaki and 84,000 troops to escape into Switzerland, where they were disarmed and remained till the conclusion of the war.

Meanwhile Paris had held out for a much longer period than even the most sanguine on the side of the French had expected. Desperate sallies were frequently made, but not in sufficient strength to have any decisive effect. On the failure of the last sally, on 19 January, General Trochu resigned and was succeeded by Lefló as head of the government of defense, and by General Vinoy as commander of the troops of Paris. But by this time the city was at the point of starvation, and after a three weeks' bombardment was in such a desperate condition that the government could no longer help seeing that a capitulation was inevitable. The terms were settled on 28 January, the chief being that all the forts around Paris should be immediately handed over to the Germans, and that the city should pay a contribution of 200,000,000 francs ($40,000,000). An armistice of three weeks was at the same time concluded, to allow of the election and assembling of a National assembly to decide upon war and peace. This armistice, however, was not to extend to the scene of war in the southeast until a separate arrangement had been made regarding it. Here the fortress of Belfort still held out, but at last, on 16 February, it agreed to capitulate. The garrison, on account of its gallant defense, was allowed to march out with full military honors. On the same day the armistice became general. The fortress of Bitsch in the department of Moselle, did not surrender till after the conclusion of the preliminaries of peace.

The elections for the assembly had taken place on the 8th; it met at Bordeaux, and on the 17th appointed M. Thiers head of the executive; and on the 21st he arrived at Versailles with a diplomatic commission to negotiate for peace. After the armistice had been thrice prolonged the preliminaries of peace were signed at Versailles on 26 February and accepted by the assembly at Bordeaux on 1 March. On the same day the German troops entered Paris; on 18 January King William, who had taken up his residence at Versailles, had by acclamation been proclaimed Emperor of Germany. The principal terms of peace were: (1) That France should cede to Germany one-fifth part of Lorraine, including Metz, together with the whole of Alsace except Belfort and the surrounding district. (2) That France should pay to Germany a war indemnity of 5,000,000,000 francs ($1,000,-000,000). (3) That certain departments of France should remain in the occupation of the Germans and should not be fully evacuated until after the payment of the whole indemnity. The definite treaty of peace, which was signed at Frankfort on 10 May and ratified on the 21st, confirmed in all essential particulars the preliminaries of Versailles. The last instalment of the war indemnity was paid on 5 Sept. 1873, and France was completely evacuated by the Germans on the 13th of the same month.

Bibliography.— Consult the French official account, 'La Guerre de 1870–71' (Paris 1902); the German official account, 'Der Deutsch-französische Krieg, 1870–71' (Berlin 1874–81); Von Moltke, 'The Franco-Prussian War, 1870–71,' translated by Forbes (London 1893); Chuquet, 'La Guerre de 1870–71' (Paris 1895); Herstlet, 'The Map of Europe by Treaty' (Vol. III, London 1891); F. B. Maurice's contribution in Vol. XI of the 'Cambridge Modern History,' with its exhaustive bibliography; Sohel, 'Histoire Diplomatique de la guerre Franco-allemande' (Paris 1875); Valfrey, 'Histoire du traite de Francfort' (Paris 1874–75); and the work of the United States ambassador, 'Recollections of a Minister to France' (New York 1887).

FRANÇOIS, frăṅ-swä, **Kurt von,** German explorer: b. Luxemburg, 1852. After active service in the Franco-Prussian War, he joined, with the rank of lieutenant, the Wissmann expedition to explore the river Kassai, a tributary of the Kongo, and subsequently published 'In the Interior of Africa, the Exploration of the Kassai.' He then explored with Grenfell two southern tributaries of the Kongo and published his 'Exploration of the Tschuapa and Lulongo' (1888). He was on his return promoted to be leader of an expedition which the government despatched to the colony of Togo, and accompanied the military expedition into South Africa. His maps of regions visited and historical accounts of colonization there are of value to the student of African affairs.

FRANÇOIS, Louise von, German novelist: b. Herzburg, Saxony, 27 June 1817; d. Weissenfels, 24 Sept. 1893. Her first important story, 'The Last Reckenburgerin' (1871), was very warmly praised by the critics for its power in character delineation; it was followed by 'Frau Erdmuthen's Twin Boys' (1872); 'Climacteric Years of a Lucky Fellow' (1877); 'Judith the Housekeeper' (1878), a peasant counterpart to 'The Last Reckenburgerin,' and next after that her best story. She wrote a 'Popular History of the Prussian War of Liberation, 1813–15'; and a comedy, 'Woman's Station' (1882).

FRANÇOIS DE NEUFCHATEAU, nĕf'-chă-tō', **Nicolas Louis François,** COUNT; French poet and statesman: b. Lorraine, 1750; d. Paris, 1828. He was educated at the Jesuit College of Neufchâteau, and received this name in 1765 when a volume of poetry published by him attained considerable vogue. In 1770 he was appointed professor of rhetoric at Toul, and in 1783–88 he was procureur général in San Domingo. Later he was deputy to the National assembly and to the legislative assembly, of which he became secretary and was for a time its president. He published, in 1793, a comedy entitled 'Paméla, ou la vertu recompensée' which led to his imprisonment. In 1797 under the Directory he was Minister of the Interior, and during his tenure did much for inland navigation and for industrial exhibitions. He was president of the Senate in 1804–06, and after 1815 retired from politics. Other volumes by him are 'Fables et contes en vers' (1814); and 'Les trois nuits d'un goutteux' (1819). He wrote also many articles on agriculture and miscellaneous subjects and translations. Consult Lamoureux, 'Nicolas Louis François de Neufchâteau' (Paris 1843), and Simian, 'François de Neufchâteau et les expositions' (ib. 1889).

FRANCOLIN, a kind of small partridge belonging to the genus Francolinus of the family Phasianidæ of Africa and southern Asia, much resembling the American bobwhite in behavior. One species (*Francolinus vulgaris*) used to be common in the south of Europe, but has been exterminated.

FRANCONIA, Germany, a district lying to the east of the Rhine, and traversed by the Main. After the dismemberment of the Carlovingian empire this district became attached to the German division, and ultimately formed one of the grand-duchies of Germany. Between 1024 and 1125 it furnished a series of emperors to Germany. (See GERMANY, *History*). It was one of the 10 circles into which the empire was divided by Maximilian I in 1512. Its capital was Nuremberg. In 1806 it was partitioned among Würtemberg, Baden, Hesse-Cassel, the Saxon duchies and Bavaria. The last received the largest share, and still retains the name in the three circles of Upper, Middle and Lower Franconia. (1) Upper Franconia has an area of 2,702 square miles and pop. 661,126. Bayreuth is the capital. (2) Middle Franconia has an area of 2,925 square miles and pop. 929,985. The capital is Anspach. (3) Lower Franconia has an area of 3,243 square miles and pop. 709,832, Würzburg is the capital. The name of Franconia has been rendered familiar to the traveler and the geologist by its picturesque scenery, which has procured for part of it the name of Franconian Switzerland, and by its caverns, filled with fossil bones, among the most remarkable of which is König Ludwig's Höhle (King Louis' Cave), between Bayreuth and Muggendorf.

FRANCONIA MOUNTAINS. See WHITE MOUNTAINS.

FRANCS-TIREURS, frăṅ'-tē'rėr' (Fr., free shooters; «snipers»), name given to bands of French soldiers whose exploits came into general notice during the Franco-German War of 1870–71. They originated in 1867–70 when military societies sprang up in northern France. They were not well organized at first, and waged an irregular warfare against small enemy detachments, lines of communication, etc. The Germans refused to recognize them as belligerents of military standing, and when captured they were summarily executed.

In November 1870, they were incorporated with the regular army, became better organized, and co-operated in the movements of the regular army. They continued to wage a guerilla warfare for some time after the main bodies of French troops had been defeated and captured. The most spectacular exploit of this corps was the destruction of the Moselle Railway Bridge on 21 Jan. 1871. Consult Saint Etienne, 'Les Chasseurs des Vosges' (Toul 1906). See FRANCE; ARMY.

FRANCUCCI, frăn-koo'-chē, **Innocenzo.** See IMOLA, INNOCENZA DA.

FRANEKER, fră'ne-kėr, a town in Friesland, Netherlands, once the residence of the Frisian nobles, whose castles were numerous. Here lived and died the Belgian mystic Antoinette Bourignon: b. 13 Jan. 1616; d. 30 Oct. 1680, whose writings excited theologians in Europe for over a century, and with whom William Penn was in correspondence. She was a follower of Jean de Labadie. The plantarium, in the town hall, made by Eise Elsinga (1774–1881) shows the movements of the heavenly bodies. Here are the botanical specimens, from the famous university founded in 1585, which was suppressed by Napoleon in 1811, for its ultra-democratic proclivities. The same building contains portraits of several British scholars who came later to America, one of them being that of Amesius (Prof. William Ames, 1576–1633), whose 'Marrow of Theology' is still read in Holland and Scotland. "Few Englishmen have exercised so formative and controlling an influence on European thought as Ames." He died in Rotterdam, but his wife, son and daughter and his valuable library reached New England. At Franeker University, before 1780, the agitation began which led to the recognition of the United States as a nation, expressed in writing, oratory and a great torchlight procession in honor of the young republic beyond the Atlantic. Consult Boeles, 'Friesland's Hooge School' (1878); and Griffis, 'The American in Holland' (1899).

FRANGIPANI, frän'jė-pä'nē, (1) illustrious Roman family, founded in 1014 by Leo Frangipani and which reached the zenith of its power in the 11th and 12th centuries. Its castles and fortresses were in the neighborhood of the Arch of Titus and the Coliseum. The family was a rival of the powerful house of the Pierleoni, and their differences caused repeated troubles to both the State and the Church. The Frangipani were for long partisans of the emperor but later espoused the papal cause. (2) A noble family of Croatia, distinguished for its services in the struggle against the Turks. The most celebrated members of this family were John Frangipani, who in 1390 was Ban of Croatia, Dalmatia and Slavonia, and Christopher Frangipani who fought at Mohács in 1526. Francis Frangipani joined in a conspiracy against Leopold I in 1670 with the object of restricting Germanic influence in Hungary and of spreading that of the Magyar. The conspiracy being detected Francis paid the penalty with his life in 1671. Consult Gregorovius, 'Rome in the Middle Ages' (London 1896–97).

FRANGULA, the bark of *Rhamnus Frangula,* used in medicine as a purgative.

FRANGULIN ($C_{21}H_{20}O_9$), a dyestuff extracted from the root, bark, fruit and seed of the alder buckthorn (*Rhamnus frangula*). It is a bright yellow silky, crystalline mass, without taste or smell, which fuses on heating, and can be sublimed in golden needles. It is not soluble in water, and though soluble in hot alcohol separates very completely on cooling. It dissolves in alkalies with a purple color, and is decomposed by sulphuric acid with a succession of colors. It forms lakes with metallic hydrates, and dyes silk, wool and cotton. In its chemical constitution it is a glucoside, and it is probably the same as *cascara sagrada.*

FRANK, fränk, **Jacob** (properly **Lebowicz**), Jewish pseudo-Messiah: b. Galicia, 1720; d. 10 Dec. 1791. The name Frank was obtained during travel in the east from the Turks, who employed the word as a generic term for an European. Originally a distiller, he settled, after his eastern journey, in Podolia, where he professed himself a second Messiah, basing his teachings, in opposition to the Talmud, on the Sohar, the source of the Cabbala. An outcome of the Messianic mysticism of Sabbetai Zebi, in the middle of the 18th century, he started the movement, in behalf of spiritual freedom, so he claimed, but the moral laxity which followed alarmed the rabbinical authorities, who were unable to suppress the agitation. He was imprisoned by the Poles for a number of years, but was set free by the Russians after their invasion of Poland. He then removed to Offenbach, a small city near Frankfort-on-Main, where he lived regally on the gifts of adherents and finally became a Roman Catholic. His death by apoplexy broke down popular belief in his immortality, but for a number of years his daughter succeeded in continuing the existence of the Frankist beliefs. The sect of Frankists persisted for some time in Poland, Turkey and Moldavia, its tenets being a Judaized form of the Roman Catholic faith. Consult Grätz, H., 'Frank und die Frankisten' (Breslau 1868); id., 'History of the Jews' (Vol. V, Philadelphia 1895); Kraushaar, A., 'Frank i Frankisci Polsky' (2 vols., Cracow 1895); Morfill, W. R., 'Frank and the Polish Frankists' (in *Academy,* Vol. XLIX, p. 73, London 1895); Przyborowski, W., 'Historya Franka i Frankistow' (Cracow 1893).

FRANK, Johann Peter, German physician: b. Rothalben, Bavaria, 1745; d. 1821. He studied medicine at the universities of Heidelberg and Strassburg, was professor at Pavia 1785–95, when he was made director of the Vienna General Hospital, where he remained until 1804. Afterward he was for a short time professor of medicine at Vilna, Russia, and was physician in ordinary to Tsar Alexander I. He returned to Vienna in 1808. He exerted a wide influence upon the development of medical practice in Lombardy, Austria and Russia. He made great improvements in public sanitation methods, wrote much on this subject and has been called the founder of modern sanitation. A good deal of the legislation on this subject is based on his recommendations. His principal works are 'System einer vollständigen medizinschen Polizeri (6 vols., 1779–1819; supplement, 3 vols., 1812–27; trans. into Italian 1808–30); 'De Curandis Hominum Morbis

Epitome' (6 vols., 1792–1821; German trans., 3d ed., 1840–41); 'System der landwirschaftlichen Polizei' (1789–91); 'Selbstbiographie' (1802). Consult Seiler, 'Peter Frank' (Dresden 1895).

FRANKALMOIGNE, frank'ăl-moin', form of feudal tenure whereby lands were held by religious houses or persons for charitable purposes. By the ancient common law of England, a man could not alien lands which came to him by descent without the consent of his heir, but he might give a part to God in free alms. It was an old Saxon tenure and was continued under Norman rule. This is the tenure by which almost all the ancient monasteries and religious houses held their lands, and by which the parochial clergy and very many ecclesiastical foundations hold them at this day in England. See FEUDALISM; TENURE.

FRANKAU, fränk'ow, **Mrs. Julia.** See DANBY, FRANK.

FRANKEL, Zacharias, German Jewish theologian: b. Prague, 1 Oct. 1801; d. Breslau, 13 Feb. 1875. He was eminent for his work in rabbinical jurisprudence; as magazine editor (1844–46, 1851–68) promoting the study of Jewish history and Semitic lore, and as director of the Breslau Seminary (1854–74), which he made the most famous in his day. He was the leader of what was termed the positive historical school, and exerted a powerful influence against obscurantism and radicalism. His works include 'The Jewish Oath, in its Theological and Historical Relations' (1840–47); 'Studies on the Septuagint' (1841); 'Introduction to the Mishnah' (in Hebrew, 1860), and 'Introduction to the Palestinian Talmud' (1870).

FRANKENBERG, Germany, town of Saxony, 32 miles southwest of Dresden, an important industrial centre. It manufactures cottons, woolens, carpets, silks, dyes, furniture, castings, machinery, cigars and draperies, and has the largest calico-printing works in Saxony. It contains a gymnasium, trade school, textile school and a teachers' seminary. In the neighborhood are many ruined castles and churches, at one of which is a memorial iron cross to the poet Körner. Pop. 13,576.

FRANKENHAUSEN, fränk'en-how'sen, Germany, town of the principality of Schwarzburg-Rudolstadt, 27 miles northwest of Weimar, on the Wipper. There is a gymnasium, a technical institute, and a teachers' seminary. It manufactures cigars, sugar and articles of mother-of-pearl and contains productive salt springs. Its baths are famed for curing scrofula. There are mines of lignite, and sandstone quarries in the neighborhood. Nearby also is the Barbarossa cave, discovered in 1865. Here on 15 May 1525 the Brunswick, Hessian and Saxon forces defeated the insurrection of the peasants led by Münzer. Pop. 6,600.

FRANKENSTEIN, frănk'en-stīn. The famous romance of 'Frankenstein' was begun by Mrs. Shelley in the summer of 1816, while she was staying with her husband the poet, Lord Byron and another friend in Switzerland by Lake Geneva; it was completed at Marlow, in England, the next year and published in 1818. On wet evenings the little Swiss party of four used to read German ghost stories; and at the suggestion of Byron, they entered into a half-serious compact that each should write one for the amusement of the company. Only Mrs. Shelley quite fulfilled the engagement. The outline of her story came to her in a dream — that is, in a horrible nightmare — one night after she had been greatly excited by a conversation between Byron and her husband over the possibility of creating and endowing a being with life. This problem Frankenstein, a young student in chemistry and anatomy, succeeds in solving. But the creature whom he builds up in his laboratory and infuses with life turns out to be a huge male monster eight feet in height, with long ragged hair, and rolling, blood-shot eyes, and yellow features so distorted and loathsome that no one can look upon them an instant without a scream of terror. Cut off from all association with mankind, the hideous giant resolves upon war against the whole human species and above all others against the man who had formed him and sent him forth to unsupportable misery. One by one he slays, or brings to death from grief, all the members of Frankenstein's family and all his dearest friends including his bride. At last, Frankenstein, unable to overtake and kill the being fashioned by his hands, dies of exhaustion and remorse; and the monster, repentant for his crimes, disappears in the darkness of the northern seas.

In this romance, Mrs. Shelley reached the goal for which she set out — which was to write as horrible a tale as she had ever read. In her own words: "One which would speak to the mysterious fears of our nature, and awaken thrilling horror — one to make the reader dread to look round, to curdle the blood, and quicken the beatings of the heart." She also lived to know that she had added a new word to the English language. Frankenstein is now a synonym for a man whose own works bring him to disaster or destruction. And as the monster of the romance bears no name, the name of his creator has been often transferred to him so that "a Frankenstein" has come also to signify, in popular usage, a being of the most appalling ugliness and brutality, having no trace of the moral sense whatever.

WILBUR L. CROSS.

FRANKENTHAL, fränk'en-täl, Germany, a manufacturing city of the Bavarian Palatinate, 10 miles northwest of Mannheim near the Rhine. It has machine shops, iron foundries and sugar refineries, manufactories of dynamos, machinery, boilers, cooperage works, corks, toys, soap, bells and cement works. A canal connects it with the Rhine. The town dates from the 8th century. Its abbey church, dating from 1119, is the chief object of interest. The town erected a monument to those who took part in the war against Napoleon I. Pop. 18,779.

FRANKFORT, Ind., city and county-seat of Clinton County; on the Chicago, Indianapolis and Louisville (Monon), Lake Erie and Western, Toledo, Saint Louis and Western (Clover Leaf), and the Pennsylvania railroads (including a new double-track road, Indianapolis to Frankfort), and the Terre Haute, Indianapolis and Eastern and Kokomo, Marion and Western traction lines; 47 miles northwest of Indianapolis and 91 miles southwest of Fort Wayne. It is situated in an agricultural section and its chief manufactures are flour, butter, canned goods, lumber, cigars, plumbers' brass goods, tool handles, kitchen cabinets, stoves and furnaces. The trade is chiefly in the manufactured articles and grain, fruits and vegetables. The city has a fine public library and a well organized system of public schools. There are five grain elevators (22 in the county). The electric light plant is owned by the city. Pop. 9,596.

FRANKFORT, Ky., city, capital of the State of Kentucky, county-seat of Franklin County; on the Kentucky River, the Chesapeake and Ohio, Frankfort and Cincinnati and the Louisville and Nashville railroads; 55 miles by rail east of Louisville and 65 miles southwest of Cincinnati. The city was founded by Gen. James Wilkinson (q.v.) in 1786, and for a time it was made the seat of his intrigues when he was trying to detach Kentucky from the Union and affiliate it with Spain. When Kentucky was admitted as a State in 1792 Frankfort was made the capital. During the Civil War it was for a time the headquarters of the Confederate forces under Braxton Bragg (q.v.). On 4 Oct. 1862 Richard Hawes was inaugurated here as the Confederate governor of Kentucky. In 1900 there was great excitement in Frankfort as to who was elected governor of the State. It was decided that William Goebel was the governor-elect. In the midst of the agitation Goebel was assassinated. Frankfort owes much of its present prosperity to its location in the «Blue Grass» section of the State. Its chief manufactures are flour, whisky, lumber, carriages, twine, shoes and furniture. The United States census of manufactures for 1914 showed within the city limits 31 industrial establishments of factory grade, employing 878 persons; 546 being wage-earners receiving annually a total of $271,000 in wages. The capital invested aggregated $4,094,000 and the year's output was valued at $4,755,000: of this, $1,996,000 was the value added by manufacture. The city is the trade centre for an extensive region; the river is navigable and by artificial means it is made to furnish a large amount of water power. The city contains the State arsenal, a State home for feeble-minded children, a State penitentiary, the State Normal School for colored pupils and Saint Joseph's Academy. The State government buildings and the State library with over 100,000 volumes add to the interests of the city. Franklin cemetery contains the grave of Daniel Boone (q.v.) and other noted men connected with the history of Kentucky. Pop. 11,080.

FRANKFORT, N. Y., village in Herkimer County, 10 miles from Utica, on the West Shore Railroad and on the Erie Canal. Its industrial establishments include agricultural implement works, and road-making machinery factories, and the Gates match factory, one of the first in the country. The village has a public library. The village owns its waterworks and electric-lighting plant. Pop. 4,213.

FRANKFORT, Council of, the assembly convened at Frankfort-on-the-Main by Charles the Great in 794. It was attended by all the bishops of the Frankish kingdom, together with many ecclesiastics, and also by the bishops of Italy and Aquitania and by some ecclesiastics from England. It condemned the doctrine of Adoptianism as propounded by Elipandus and Felix. It also condemned the rendering of Latreia (worship due to God alone) to images. Its canons also touch upon many matters of discipline and doctrine. Consult Hefele, 'Conciliengeschichte' (Freiburg 1874); Migne, 'Patrologia Latina,' xcvii; and Mombert, 'Charles the Great' (New York 1888).

FRANKFORT LAND COMPANY, 1686. Francis Daniel Pastorius (q.v.), an able young German lawyer, had joined the sect of Pietists (q.v.), and to escape from the atmosphere of Lutheranism concerted with his coreligionists an emigration to America. A number of wealthy and distinguished Germans and Dutchmen were induced to join; but they soon gave up the idea of emigrating themselves, and wished Pastorius instead to head a colony of German and Dutch Mennonites and Quakers to a land where they need not be harried. Pastorius had made Penn's acquaintance in England, had become a Quaker, and wished to be near Penn; some Frankfort and Crefeld merchants bought from Penn 15,000 acres near Philadelphia, and had formed a land company, calling it the German Society. They were all friends of Pastorius, who himself was one of the original purchasers. He was appointed factor of the company and in 1683 conducted a colony thither, and at once laid out Germantown (q.v.). In 1686 the land company was reorganized as the Frankfort Land Company, after its holdings had been increased to 25,000 acres. Consult Learned, M. D., 'Francis Daniel Pastorius' (in *German American Annals,* Vols. IX and X [U. S. Vols. V and VI], Philadelphia 1907–08).

FRANKFORT-ON-THE-MAIN, mān, Prussia, the capital of a district of same name, on both banks of the navigable river Main, 24 miles above its confluence with the Rhine. It is divided by the river into two unequal parts; the one on the north bank, called Frankfort proper, being considerably larger than the other, which is called Sachsenhausen; and the two communicate by several bridges. Frankfort was formerly fortified; but most of its outworks are now converted into gardens and promenades, and it is entered by nine gates. The principal streets are wide; there are also many squares and a number of large buildings, among which may be named the Rœmerberg, or old palace, in which the emperors of Germany were elected, and place of the assembling of the Diet; the Taxis palace, a place of residence of the emperors; the Sallhof, a modern imperial palace; an academy of painting, and the Senkenberg Museum. Its manufactures include carpets, table-covers, oilcloths, cotton and silk fabrics, woolen stuffs, jewelry, tobacco and printer's black. It has also large printing, lithographic and stereotyping establishments. Charlemagne, who had a palace in this city, summoned a council in 794, and it was surrounded with walls by Louis I in 838. It was the capital of the Eastern Franks from 843 to 889, when Ratisbon was selected. Frederick I was elected at Frankfort in 1152. From that time it became the place of election of the German kings and emperors. Frankfort was made a free city in 1245. Frederick of Prussia signed a treaty known as the Union of Frankfort, with the empire, France and Sweden, at this city, 13 May 1744. The French captured it 2 Jan. 1750, and again in sembly of Pennsylvania a delegate to the Continental Congress which consolidated the armies of the colonies, placed Gen. George Washington in command of them, issued the first Continental currency, and assumed the responsibility of resisting the imperial government; his last hope of maintaining the integrity of the empire having been dissipated by recent collisions between the people and the royalist troops at Concord and Lexington. Franklin served on 10 committees in this Congress. He was one of the five who drew up the Declaration of Independence in July 1776, and in September following was chosen unanimously as one of the three commissioners to be sent out to solicit for the infant republic the aid of France and the sympathies of continental Europe. In this mission, the importance of which to his country can hardly be exaggerated, he was greatly favored by the reputation which had preceded him as a man of science. While yet a journalist he had made some experiments in electricity, which established its identity with lightning. The publication by an English correspondent of the letters in which he gave an account of these experiments secured his election as an honorary member of the Royal Society of London and undisputed rank among the most eminent natural philosophers of his time. When he arrived in Paris, therefore, he was already a member of every important learned society in Europe, one of the managers of the Royal Society of London, and one of the eight foreign members of the Royal Academy in Paris, where three editions of his scientific writings had already been printed. To these advantages must be added another of even greater weight: his errand there was to assist in dismembering the British Empire, than which nothing of a political nature was at this time much nearer every Frenchman's heart. See GREAT SEAL OF THE UNITED STATES.

The history of this mission, and how Franklin succeeded in procuring from the French king financial aid to the amount of 26,000,000 francs, at times when the very existence of the republic depended upon them, and finally a treaty of peace more favorable to his country than either England or France wished to concede, has been often told; and there is no chapter in the chronicles of this republic with which the world is more familiar.

Franklin's reputation grew with his success. «It was,» wrote his colleague John Adams, «more universal than that of Leibnitz or Newton, Frederick the Great or Voltaire, and his character more beloved and esteemed than all of them. . . . If a collection could be made of all the gazettes of Europe of the latter half of the 18th century, a greater number of panegyrical paragraphs upon *le grand Franklin* would appear, it is believed, than upon any other man that ever lived.»

A few weeks after signing the definite treaty of peace in 1783, Franklin renewed an application which he had previously made just after signing the preliminary treaty, to be relieved of his mission, but it was not until 7 March 1785 that Congress adopted a resolution permitting «the Honorable Benjamin Franklin to return to America as soon as convenient.» Three days later, Thomas Jefferson was appointed to succeed him. On 13 Sept. 1785, and after a sojourn of nearly nine years in the French capital, first in the capacity of commissioner and subsequently of minister plenipotentiary, Franklin once more landed in Philadelphia, on the same wharf on which, 62 years before, he had stepped, a friendless and practically penniless runaway apprentice of 17. Though now in his 79th year, and a prey to infirmities not the necessary incidents of old age, he had scarcely unpacked his trunks after his return when he was chosen a member of the municipal council of Philadelphia, and its chairman. Shortly after, he was elected president of Pennsylvania, his own vote only lacking to make the vote unanimous. «I have not firmness,» he wrote to a friend, «to resist the unanimous desire of my country folks; I find myself harnessed again into their service another year. They engrossed the prime of my life; they have eaten my flesh, and seem resolved now to pick my bones.»

He was unanimously re-elected to this dignity for the two succeeding years, and while holding that office was chosen a member of the convention which met in May 1787 to frame the Constitution under which the people of the United States are still living. With the adoption of that instrument, to which he probably contributed as much as any other individual, he retired from official life; though not from the service of the public, to which for the remaining years of his stay on earth his genius and his talents were faithfully consecrated. Among the fruits of that unfamiliar leisure, always to be remembered among the noblest achievements of his illustrious career, was the part he had in organizing the first anti-slavery society in the world; and as its president, writing and signing the first remonstrance against slavery ever addressed to the Congress of the United States.

In surveying the life of Dr. Franklin as a whole, the thing that most impresses one is his constant study and singleness of purpose to promote the welfare of human society. It was his daily theme as a journalist, and his yearly theme as an almanac-maker. It is that which first occurs to us when we recall his career as a member of the Colonial assembly; as an agent of the provinces in England; as a diplomatist in France; and as a member of the conventions which crowned the consistent labors of his long life. Nor are there any now so bold as to affirm that there was any other person who could have been depended upon to accomplish for his country or the world what Franklin did in any of the several stages of his versatile career.

Though holding office for more than half of his life, the office always sought Franklin, not Franklin the office. When sent to England as the agent of the colony, he withdrew from business with a modest competence judiciously invested mostly in real estate. He never seems to have given a thought to its increase. Frugal in his habits, simple in his tastes, wise in his indulgences, he died with a fortune neither too large nor too small for his fame as a citizen or a patriot. For teaching frugality and economy to the colonists, when frugality and economy were indispensable to the conservation of their independence and manhood, he has been sneered at as the teacher of a «candle-end-saving philosophy,» and his 'Poor Richard' as a «collection of receipts for laying up treasures on earth rather than in heaven." Franklin never taught, either by precept or example, to lay up treasures on earth. He taught the virtues of industry, thrift and economy as the virtues supremely important in his time, to keep people out of debt and to provide the means of educating and dignifying society. He never countenanced the accumulation of wealth for its own sake, but for its uses,— its prompt convertibility into social comforts and refinements. It would be difficult to name another man of any age to whom an ambition to accumulate wealth as an end could be imputed with less propriety. Though probably the most inventive genius of his age, and thus indirectly the founder of many fortunes, he never asked a patent for any of his inventions or discoveries. Though one of the best writers of the English language that his country has yet produced, he never wrote a line for money after he withdrew from the calling by which he made a modest provision for his family.

For the remaining half of his life both at home and abroad, though constantly operating upon public opinion by his pen, he never availed himself of a copyright or received a penny from any publisher or patron for any of these labors. In none of the public positions which he held, even when minister plenipotentiary, did his pay equal his expenditures. He was three years president of Pennsylvania after his return from France, and for his services declined to appropriate to his own use anything beyond his necessary expenditures for stationery, postage and transportation. It is not by such methods that men justly incur the implied reproach of "laying up treasures on earth," or of teaching a candle-end-saving philosophy.

Franklin courted fame no more than fortune. The best of his writings, after his retirement from journalism, he never gave to the press at all; not even his incomparable autobiography, which is still republished more frequently than any of the writings of Dickens or of Thackeray. He always wrote for a larger purpose than mere personal gratification of any kind. Even his bagatelles and *jeux d'esprit* read in the salons of Paris, though apparently intended for the eyes of a small circle, were inspired by a desire to make friends and create respect for the struggling people and the great cause he represented. Few if any of them got into print until many years after his decease. Franklin was from his youth up a leader, a lion in whatever circle he entered, whether in the printing-house, the provincial assemblies, as agent in England, or as a courtier in France. There was no one too eminent in science or literature, on either side of the Atlantic, not to esteem his acquaintance a privilege. He was an honorary member of every important scientific association in the world, and in friendly correspondence with most of those who conferred upon those bodies any distinction; and all this by force of a personal, not to say planetary, attraction that no one brought within his sphere could long resist.

Pretty much all of importance that we know of Franklin we gather from his private correspondence. His contemporaries wrote or at least printed very little about him; scarcely one of the multitude whose names he embalmed in his 'Autobiography' ever printed a line about him. All that we know of the later half of his life not covered by his autobiography, we owe almost exclusively to his private and official correspondence. Though reckoning among his warm friends and correspondents such men as David Hume, Dr. Joseph Priestly, Dr. Price, Lord Kames, Lord Chatham, Dr. Fothergill, Peter Collinson, Edmund Burke, the bishop of Saint Asaph and his gifted daughters, Voltaire, the habitués of the Helvétius salon, the Marquis de Ségus, the Count de Vergennes, his near neighbors De Chaumont and Le Veillard the *maire* of Passy,— all that we learn of his achievements, of his conversation, of his daily life, from these or many other associates of only less prominence in the Old World, might be written on a single foolscap sheet. Nor are we under much greater obligations to his American friends. It is to his own letters (and except his 'Autobiography,' he can hardly be said to have written anything in any other than the epistolary form; and that was written in the form of a letter to his son William, and most of it only began to be published a quarter of a century after his death), that we must turn to learn how full of interest and importance to mankind was this last half-century of his life. Beyond keeping copies of his correspondence, which his official character made a duty as well as a necessity, he appears to have taken no precautions to insure the posthumous fame to which his correspondence during that period was destined to contribute so much. Hence, all the biographies — and they are numberless — owe almost their entire interest and value to his own pen. All, so far as they are biographies, are autobiographies; and for that reason it may be fairly said that all of them are interesting.

It is also quite remarkable that though Franklin's life was a continuous warfare, he had no personal enemies. His extraordinary and even intimate experience of every phase of human life, from the very lowest to the very highest, had made him so tolerant that he regarded differences of opinions and of habits much as he regarded the changes of the weather,— as good or bad for his purposes, but which, though he might sometimes deplore, he had no right to quarrel with or assume personal responsibility for. Hence he never said or did things personally offensive. The causes that he represented had enemies, for he was all his life a reformer. All men who are good for anything have such enemies. "I have, as you observe," wrote Franklin to John Jay the year that he retired from the French mission, "some enemies in England, but they are my enemies as an American; I have also two or three in America who are my enemies as a minister; but I thank God there are not in the whole world any who are my enemies as a man; for by His grace, through a long life I have been enabled so to conduct myself that there does not exist a human being who can justly say, 'Ben Franklin has wronged me.' This, my friend, is in old age a comfortable reflection. You, too, have or may have your enemies; but let not that render you unhappy. If you make a right use of them, they will do you more good than harm. They point out to us our faults; they put us upon our guard and help us to live more correctly."

Franklin's place in literature as a writer has not been generally appreciated, probably because with him writing was only a means, never an end, and his ends always dwarfed his means, however effective. He wrote to persuade others, never to parade his literary skill. He never wrote a dull line, and was never nimious. The longest production of his pen was his autobiography, written during the closing years of his life. Nearly all that he wrote besides was in the form of letters, which would hardly average three octavo pages in length. And yet whatever the subject he touched upon, he never left the impression of incompleteness or of inconclusiveness. Of him may be said, perhaps with as much propriety as of any other man, that he never said a word too soon, nor a word too late, nor a word too much.

The Doric simplicity of his style; his incomparable facility of condensing a great principle into an apologue or an anecdote, many of which, as he applied them, have become the folk-lore of all nations; his habitual moderation of statement, his aversion to exaggeration, his inflexible logic, and his perfect truthfulness,— made him one of the most persuasive men of his time, and his writings a model which no one can study without profit. A judicious selection from Franklin's writings should constitute a part of the curriculum of every college and high school that aspires to cultivate in its pupils a pure style and correct literary taste.

There was one incident in Franklin's life, which though more frequently referred to in terms of reproach than any other, will probably count for more in his favor in the Great Assize than any other of his whole life. While yet in his teens he became a father before he was a husband. He never did what men of the loftiest moral pretensions not unfrequently do,— shirk as far as possible any personal responsibility for his indiscretion. On the contrary, he took the fruit of it to his home; gave him the best education the schools of the country then afforded. When he went abroad, this son accompanied him, was presented as his son wherever he went, was presented in all the great houses in which he himself was received; he entered him at the Inns of Court, and in due time had him admitted to the English bar; made him his private secretary, and at an early age caused him to be appointed by the Crown governor of New Jersey. The father not only did everything to repair the wrong he had done his son, but at a time when he was at the zenith of his fame and official importance, publicly proclaimed it as one of the great errors of his life. The world has always abounded with bastards, but with the exception of crowned heads claiming to hold their sceptres by divine right, and therefore beyond the reach of popular criticism or reproach, it would be difficult to name another parent of his generation of anything like corresponding eminence with Franklin, who had the courage and the magnanimity to expiate such a wrong to his offspring so fully and effectively.

Franklin was not a member of the visible church, nor did he ever become the adherent of any sect. With the Unitarian creed Dr. Franklin had more in common than with any other, though he was much too wise a man to suppose that there was but one gate of admission to the Holy City.

Franklin made a somewhat more definite statement of his views on the subject of religion, in reply to an inquiry from President Styles of Yale College, who expressed a desire to know his opinion of Jesus of Nazareth. Franklin's reply was written the last year of his life, and in the 84th of his age:

«You desire to know something of my religion. It is the first time I have been questioned upon it. But I cannot take your curiosity amiss, and shall endeavor in a few words to gratify it. Here is my creed. I believe in one God, the creator of the universe. That He governs it by His providence. That He ought to be worshipped. That the most acceptable service we render to Him is doing good to His other children. That the soul of man is immortal and will be treated with justice in another life respecting its conduct in this. These I take to be the fundamental points in all sound religion, and I regard them as you do in whatever sect I meet with them.

«As to Jesus of Nazareth, my opinion of whom you particularly desire, I think His system of morals and His religion, as He left them to us, the best the world ever saw or is like to see; but I apprehend it has received various corrupting changes, and I have, with most of the present Dissenters in England, some doubts as to His divinity; though it is a question I do not dogmatize upon, having never studied it, and think it needless to busy myself with it now, when I expect soon an opportunity of knowing the truth with less trouble. I see no harm, however, in its being believed, if that belief has the good consequence, as probably it has, of making His doctrines more respected and more observed; especially as I do not perceive that the Supreme takes it amiss, by distinguishing the unbelievers in His government of the world with any peculiar marks of His displeasure.

«I shall only add, respecting myself, that, having experienced the goodness of that Being in conducting me prosperously through a long life, I have no doubt of its continuance in the next, though without the smallest conceit of meriting such goodness. My sentiments on this head you will see in the copy of an old letter enclosed, which I wrote in answer to one from an old religionist whom I had relieved in a paralytic case by electricity, and who, being afraid I should grow proud upon it, sent me his serious though rather impertinent caution.» See FRANKLIN'S AUTOBIOGRAPHY.

Bibliography.—A list of works by or relating to Benjamin Franklin appeared in the *Bulletin* of the New York Public Library for January 1906; Ford, W. C., 'List of the Benjamin Franklin Papers in the Library of Congress' (Washington 1905); Ford, P. L., 'Franklin Bibliography: a List of Books written by or relating to Benjamin Franklin' (Brooklyn 1889); 'Autobiography' (edited by John Bigelow, Philadelphia 1868); 'Life of Benjamin Franklin, written by Himself' (edited by Bigelow, rev. ed., ib., 1888); 'Complete works' (10 vols., edited by Bigelow, New York 1887–88); Mignet, F. A. M., 'Vie de Franklin' (Paris 1848); Parton, J., 'Life and Times of Benjamin Franklin' (New York 1867); McMaster, J. B., 'Benjamin Franklin, as a Man of Letters' (Boston 1887); Hale, E. E. and E. E., Jr., 'Franklin in France' (ib. 1887–88); Morse, J. T., 'Benjamin Franklin' (ib. 1889); Ford, P. L. (edited), 'Sayings of Poor Richard' (New York 1890); Ford, P. L., 'The

Many-Sided Franklin' (ib. 1899); Fisher, S. G., 'The True Benjamin Franklin' (Philadelphia 1899); More, P. E., 'Benjamin Franklin' (Boston 1900); Oswald, S. C., 'Benjamin Franklin, Printer' (1918).

JOHN BIGELOW.

FRANKLIN, Christine Ladd, American scientist: b. Windsor, Conn., 1 Dec. 1847. She was graduated at Vassar College in 1869; studied at the University of Johns Hopkins 1878–82 under Sylvester and others and later at Göttingen and Berlin. In 1882 she was married to Fabian Franklin. Her theory of color-vision, which she published in 1892, attracted wide attention in America and Europe. Until 1909 she had charge of the department of physiological optics in the *Psychological Review.* In 1901–02 she was an associate editor of Baldwin's 'Dictionary of Philosophy and Psychology' and lectured in logic and psychology at Johns Hopkins during 1904–09, and since 1910 at Columbia University. From her pen have come many contributions to mathematical, philosophical and psychological journals, and editorials and other articles to the *Nation,* etc. In 1887 Vassar College conferred upon her the degree of LL.D.

FRANKLIN, Edward Curtis, American chemist: b. Geary City, Kan., 1 March 1862. He was graduated at the University of Kansas in 1888, and also studied at the University of Berlin and at Johns Hopkins. He was assistant in chemistry 1888–93, associate professor 1893–99, and professor of physical chemistry 1899–1903 at the University of Kansas. In 1903 he was appointed associate and in 1906 professor of organic chemistry at Leland Stanford Junior University. From 1911 to 1913 he was connected with the United States Public Health Service as professor of chemistry and chief of its department of chemistry. He was a member of the United States Assay Commission in 1906. He is Fellow of the American Association for the Advancement of Science, and has published papers on the electrolytic action of ammonia, and various salts and solvents.

FRANKLIN, Fabian, American mathematician and editor: b. Eger, Hungary, 18 Jan. 1853. After his graduation from Columbian (now the George Washington) University, Washington, in 1869, he engaged in civil engineering and surveying. In 1877 he became a Fellow at Johns Hopkins University, and his advance to the associate and then full professorship of mathematics quickly followed. During his connection with Johns Hopkins, which lasted until 1895, he was a frequent contributor to mathematical and other journals. In 1895 he became editor of the Baltimore *News;* and on 1 Oct. 1909 associate editor of the New York *Evening Post.* Among his works are 'People and Problems' (1908); 'Cost of Living' (1915), and contributions to mathematical publications and *The Nation.*

FRANKLIN, SIR **John,** English navigator: b. Spilsby, Lincolnshire, 16 April 1786; d. Lancaster Sound, 11 June 1847. When only a boy he went to sea, and later entered the English navy. In 1806 he was present at the battle of Trafalgar, in 1814 at that of New Orleans, and in 1819 was appointed to head an overland expedition from Hudson Bay to the Arctic Ocean. After suffering many hardships and being frequently on the verge of death from hunger and fatigue, he reached home in 1822. In the following year he married a Miss Purden (died 1825), the daughter of an architect, and the author of several poetical effusions. In 1825 he submitted to Lord Bathurst a plan "for an expedition overland to the mouth of the Mackenzie River, and thence by sea to the northwest extremity of America, with the combined object also of surveying the coast between the Mackenzie and Coppermine rivers." This proposition was accepted, and six days after he left Liverpool, in the same year, his wife died. In 1827 Captain Franklin arrived at Liverpool, where he married as his second wife, Miss Griffen. In 1829 the honor of knighthood was conferred upon him. He commanded the *Rainbow* frigate in the Mediterranean 1830–33; and was lieutenant-governor of Van Diemen's Land 1837–43. In 1845 Sir John set out on a third expedition with two ships, called the *Erebus* and *Terror,* and his ships were last seen by a Scottish whaler on 26th July of that year. He spent his first winter in a cove between Cape Riley and Beechey Island. After that period many expeditions were dispatched, both from England and America, in search of Sir John, of whom there were no tidings, and not till 1854 did the intelligence reach England that the navigator and his companions had, in all probability, perished in the winter of 1850–51. This intelligence, however, wanted confirmation, and Lady Franklin, who deserves all praise for the intelligent persistency of her efforts, resolved to have the mystery cleared up. Accordingly a last expedition was fitted out, and the news was, in 1859, at length confirmed by the return of Captain McClintock, in the yacht *Fox,* after a persevering search for the lost adventurers. This officer brought with him indisputable proofs of the death of Sir John and the loss of his crew. Several articles belonging to the unfortunate explorers were found at Ross Cairn and Point Victory. At the latter place a record was discovered, wherein it was stated that Sir John Franklin had died 11 June 1847. Other traces were found on the west coast of King William's Island, as the various survivors of the expedition had strayed from each other, perhaps in search of food, or the means of escaping from their dreary and desolate situations. C. F. Hall, the eminent Arctic explorer, returned in September 1869 from a five-years' search for the remains of Sir John Franklin's companions, and brought back about 150 relics of the expedition, purchased from the natives of King William's Land. It remained, however, for Lieutenant Schwatka to find the bodies of the Franklin party in his expedition of 1879–80. Franklin was the author of 'Narrative of a Journey to the Shores of the Polar Sea in the Years 1819–22' (1823); 'Narrative of a Second Expedition to the Shores of the Polar Sea in 1825–27' (1828). Consult McClintock, 'Narrative of the Fate of Sir John Franklin' (1860); Osborn, 'Career, Last Voyage and Fate of Sir John Franklin' (1860); Beesly, 'Sir John Franklin' (1881); Markham, 'Life of Sir John Franklin and the Northwest Passage' (1891); Traill, 'Life of Sir John Franklin' (1896).

FRANKLIN, William, American colonial governor: b. Philadelphia, 1729 or 1730; d. England, 17 Nov. 1813. He was a natural son of Benjamin Franklin (q.v.), in whose household he was brought up. He served with the Pennsylvania forces on the Canada frontier, obtained a captain's commission before 1750, in 1754–56 was comptroller of the general post-office during part of his father's administration as Postmaster-General, and during a portion of that time clerk of the provincial assembly. In 1757 he went to England with his father, studied law in London and was admitted to the English bar in 1758. In 1762 he was appointed governor of New Jersey. During the Revolution he was a Loyalist, and kept under guard by the patriots from January 1776. In June 1776 he called a meeting of the Colonial Assembly, then abrogated, for which he was kept prisoner in Connecticut till 1778, when he was exchanged, and later went to England. It was for this son of his that Benjamin Franklin wrote his autobiography. As a result of his stand against the Revolution, an estrangement arose between father and son, which, however, disappeared before the latter's death. Consult Bigelow, J., ed., 'The Life of Benjamin Franklin, etc.' (3 vols., Philadelphia 1879); Bruce, W. C., 'Benjamin Franklin, etc.' (New York 1917); Fischer, E. J., 'New Jersey as a Royal Province, 1738–76' (in Columbia University, 'Studies in History, Economics and Public Law,' Vol. XLI, New York 1911); Hart, C. H., 'Who was the Mother of Franklin's Son' (in *Pennsylvania Magazine of History and Biography*, Vol. XXXV, p. 308, Philadelphia 1911); Ford, P. L., 'Who Was the Mother of Franklin's Son' (Brooklyn 1889); Franklin, W., 'Letters from W. Franklin to W. Strahan' (Philadelphia 1911); Lee, F. B., 'New Jersey as a Colony and a State' (4 vols., New York 1902); 'Minutes of the Provincial Congress and the Council of Safety of the State of New Jersey' (Trenton 1879); Parton, J., 'Life and Times of Benjamin Franklin' (2 vols., New York 1865); Ricord, F. W., ed., 'Archives of the State of New Jersey' (Series I, Vols. IX, X, XVII, XVIII, XXV–XXIX; Series II, Vols. I–V; Trenton 1885–1917); Sabine, L., 'Biographical Sketches of Loyalists of the American Revolution' (2 vols., Boston 1864); Whitehead, W. A., 'Contributions to the Early History of Perth Amboy, etc.' (New York 1856).

FRANKLIN, William Buel, American military officer: b. York, Pa., 27 Feb. 1823; d. Hartford, Conn., 8 March 1903. He was graduated at the United States Military Academy in 1843 at the head of his class, one of his classmates being U. S. Grant. In the Mexican War he served on the staff of General Taylor as a topographical engineer, and carried Taylor's orders at the battle of Buena Vista. After the Mexican War he served in the Engineer Corps of the army and gradually reached the rank of colonel. At the outbreak of the Civil War he was assigned to the command of a brigade in Heintzelman's division. He took part in the battle of Bull Run, served with distinction in the Peninsular campaign and was promoted major-general of volunteers in 1862. Subsequently he served under McClellan in Maryland and under Burnside at Fredericksburg (q.v.) where he commanded the left wing, was adversely criticized for his part in this battle and resigned his command. However, he returned to the army in July 1863 and was assigned to the department of the Gulf under Banks. A severe wound received in the battle of Sabine Cross Roads, 8 April 1864, incapacitated him for almost a year. In July 1864 he was captured by the Confederates, but escaped the same night. In March 1865 he was brevetted major-general in the regular army, but resigned a year later to engage in manufacturing, becoming vice-president of Colt's Automatic Firearms Manufacturing Company. He represented Connecticut as State Commissioner at the Centennial Exposition (1876), was adjutant-general of his State 1877–78, and for many years president of the board of managers of the National Home for Disabled Soldiers. He was appointed United States Commissioner-General to the Paris Exposition in 1899 and was made a grand officer of the Legion of Honor. His various reports covering his commands and operations during the Civil War may be found in United States War Department, 'War of the Rebellion. Official Records' (Series I, II and III, Washington). Consult Franklin, W. B., 'A Reply to the Report of the Joint Committee of Congress on the Conduct of the War' (New York 1863); Greene, J. L., 'General W. B. Franklin and the Operations of the Left Wing at the Battle of Fredericksburg' (Hartford 1900); Johnson, R. U., and Buel, C. C., editors, 'Battles and Leaders of the Civil War' (4 vols., New York 1884–88).

FRANKLIN, William Suddards, American educator, physicist and electrical engineer: b. Geary City, Kan., 27 Oct. 1863. He was graduated from the University of Kansas in 1887, and the same year was appointed assistant professor of physics there. After studying at Harvard and Cornell and the University of Berlin, Germany, he was appointed in 1892 to the chair of physics and electrical engineering in Iowa State College, remaining there till 1897, when he received his appointment to the same chair in Lehigh University. He is author and joint author of about 80 scientific papers and of 22 books on mathematics, physics and electrical engineering. In 1912 he published a volume of essays entitled 'Bill's School and Mine.'

FRANKLIN, a title bestowed upon the English landholders previous to the Norman conquest, who held their lands of the Crown free from any feudal servitude. In later years they lost their power and dignity, which was usurped by the Normans and became simply wealthy yeomen.

FRANKLIN, Canada, former district, and since 1905 merged into the Northwest Territories. It was formed in 1895, and comprised several islands to the north of the main land mass. The principal islands are Banks, Prince Albert, King William, Baffin Land, Prince of Wales, Melville, North Devon and Bathurst. The area is about 500,000 square miles. Being mostly within the Arctic circle it is nearly destitute of animal and vegetable life. A few Eskimos dwell on Baffin Land.

FRANKLIN, Ind., city, county-seat of Johnson County; on the Pennsylvania Railroad, Louisville Division, about 75 miles east of Terre Haute, and 20 miles south of Indianapolis. It is in an agricultural section and its chief manufactures are agricultural implements, flour and lumber. The value of taxable property is given as $2,000,000; industries, besides those mentioned, canning and light and power; resources of the four banks approximately $1,721,000. It is the seat of Franklin College, founded in 1834 by the Baptist Church, and has also one high and two graded schools. Pop. 4,502.

FRANKLIN, Ky., city, county-seat of Simpson County; on the Louisville and Nashville Railroad; about 145 miles southwest of Lexington, and five miles from the boundary line between Kentucky and Tennessee. The manufactures are woolen goods, flour, bricks and lumber. The trade is in the agricultural products of the surrounding country, and the manufactures of the town. It is the seat of the Southern Kentucky Sanatorium and the Franklin Female College. Pop. 3,063.

FRANKLIN, La., a town and parish-seat of Saint Mary Parish, 101 miles by rail southwest of New Orleans and 30 miles west of Morgan City, on Teche Bayou, and on the Southern Pacific Railroad. It is the centre of a very fertile district, and as the bayou is navigable for steamers, the town has a considerable trade in cotton, sugar, fruits, etc. There are also several saw-mills and sugar refineries located in the town. Pop. 3,857.

FRANKLIN, Mass., town in Norfolk County, 28 miles southwest of Boston, on the New York, New Haven and Hartford Railroad. The town also includes the village of Unionville. Dean Academy, an endowed co-educational school, is located here, and the town also has an almshouse, a public library and six churches. There are manufactories of pianos, straw, woolen, felt and cotton goods, printing presses, etc. It was originally a part of Wrentham, but in 1778 was separated and incorporated as a separate township. The affairs of the community are administered by town meetings. Pop. 6,440.

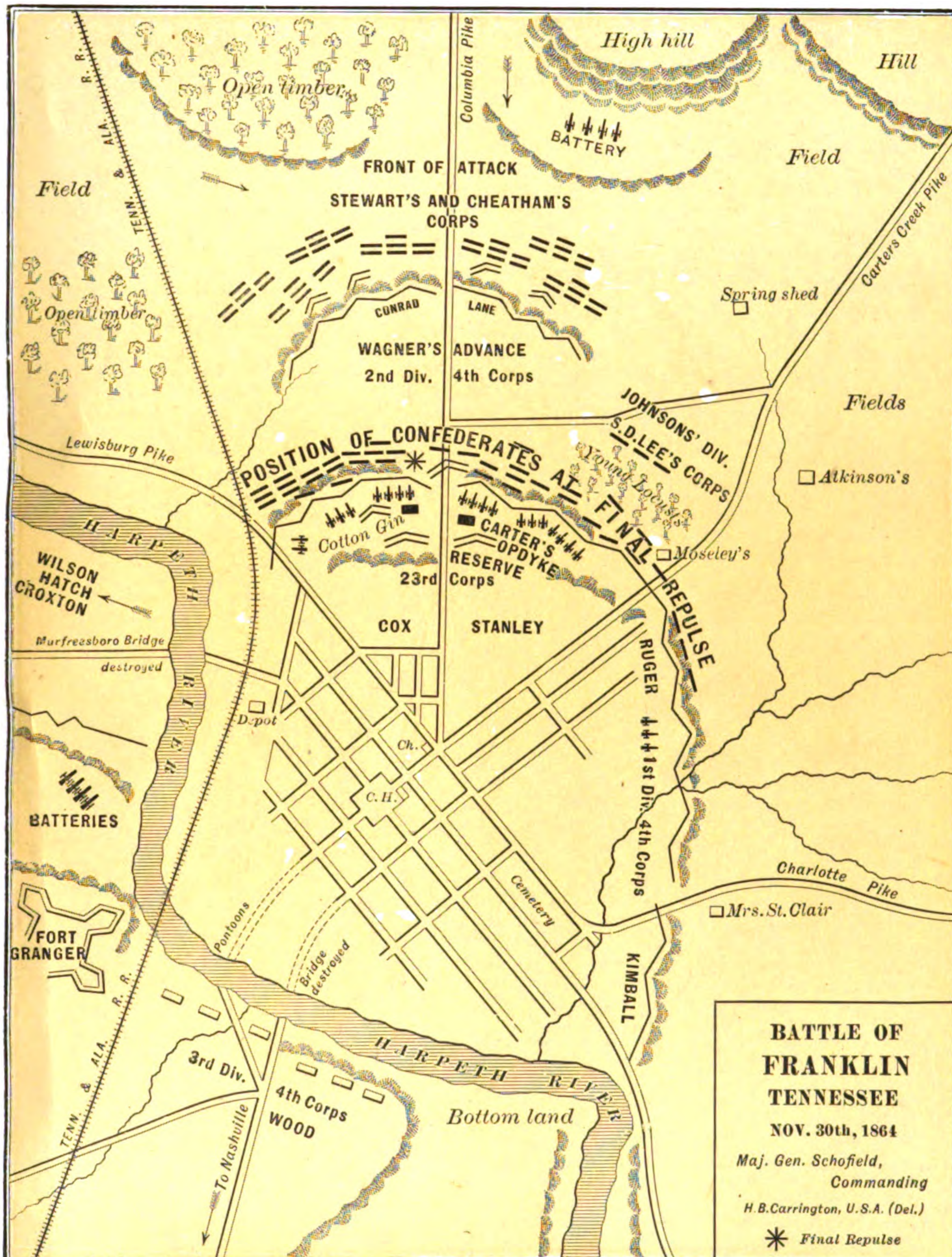
FRANKLIN, N. H., a city in Merrimac County, situated at the junction of the Pemigewasset and Winnepesauke rivers, which here unite to form the Merrimac, and on the Boston and Maine Railroad, 95 miles northwest of Boston. Owing to the abundant water power, numerous mills have located here, among which are paper and pulp mills, machine shops, woodworking shops, hosiery and knitting machine mills, woolen mills and one of the largest needle factories in the world. It is famous as the birthplace of Daniel Webster, and on the farm once owned by him now stands the New Hampshire Orphans' Home. The city owns and operates its waterworks. It was incorporated as a town in 1828 and as a city in 1895. A mayor and council administer public affairs. Pop. 6,132.

FRANKLIN, Ohio, village in Warren County, on the Cincinnati Northern Railroad; Cleveland, Cincinnati, Chicago and Saint Louis; Ohio Electric; the Big Miami River, and the Miami and Erie Canal, 40 miles northeast of Cincinnati. There are several churches, schools, paper mills, wood pulp mills and large tobacco warehouses. It was founded by Gen. William Schenck in 1796. Pop. 2,659.

FRANKLIN, Pa., a city and county-seat of Venango County, 123 miles north of Pittsburgh, on the Alleghany River, at the mouth of French Creek, and on the Erie, the Pennsylvania, the New York Central and the Franklin and Clarion railroads. The chief business is in oil, as the city is in the heart of a great oil region. There are large oil refineries, oilwell supplies and railway equipment shops and manufactures of asbestos goods, air compressors, boring machines and drills, carbon papers and office blanks and books, etc. The United States census of manufacturers for 1914 showed within the city limits 45 industrial establishments of factory grade, employing 2,002 persons; 1,479 being wage-earners receiving annually a total of $955,000 in wages. The capital invested aggregated $13,516,000, and the year's output was valued at $10,608,000: of this, $4,999,000 was the value added by manufacture. The city has beautiful parks and a public library, four banks, one high school, one union and five ward schools, one Catholic school; a State armory, city hall, courthouse, etc; the streets are provided with sewers and paved with brick. Franklin was first settled in 1753, and was incorporated in 1795. The government is of the commission form, the mayor and commissioners being elected annually. The value of the taxable property is given as $5,650,000 at about 60 per cent assessment. Pop. 10,250.

FRANKLIN, Tenn., town and county-seat of Williamson County, 20 miles south of Nashville, on the Harpeth River, and on the Louisville and Nashville and Middle Tennessee railroads. The Tennessee Female College, which was established in 1856, and the Battleground Academy are located here, and there are also several public schools and a Masonic Temple. It has flour mills, a furniture factory and a planing mill, several steam cotton gins and carriage manufactories. It was the scene of two battles during the Civil War, the first on 10 April 1863, between the Federal forces under General Granger and the Confederate forces under General Van Dorn, the latter being defeated; the second on 30 Nov. 1864, between the forces of General Hood and those of General Schofield, and which is famous as the Battle of Franklin (q.v.). Pop. 2,924.

FRANKLIN, Battle of. On 12 Nov. 1864 General Sherman turned back from his pursuit of Hood to begin his march from Atlanta to the sea, leaving General Thomas to act on the defensive in Tennessee or to take the offensive in Alabama. Hood was at Florence and Tuscumbia, on the Tennessee River, threatening Nashville, with an army of 44,000 men. Thomas' command, much smaller, was widely distributed from Chattanooga to Nashville. General Schofield was at Pulaski, Tenn., 80 miles south of Nashville. With the Fourth corps under General Stanley, a part of the 23d corps, under General Cox, and a division of cavalry, Thomas instructed Schofield to delay Hood, should he advance, until the army could be concentrated and Nashville reinforced. On the 21st Hood moved on Schofield's right. Schofield withdrew from Pulaski on the 22d, reached Columbia on the 24th, and remained there until the 27th,



BATTLE OF
FRANKLIN
TENNESSEE
NOV. 30th, 1864
Maj. Gen. Schofield,
Commanding
H.B.Carrington, U.S.A. (Del.)
Final Repulse
High hill
Hill
Open timber
Columbia Pike
BATTERY
Field
FRONT OF ATTACK
STEWART'S AND CHEATHAM'S
CORPS
TENN. & ALA. R.R.
Open timber
Spring shed
Carters Creek Pike
CONRAD
LANE
WAGNER'S ADVANCE
2nd Div. 4th Corps
JOHNSONS' DIV.
S.D.LEE'S CORPS
Fields
Young Locusts
Atkinson's
Lewisburg Pike
POSITION OF CONFEDERATES AT FINAL REPULSE
Cotton Gin
CARTER'S
OPDYKE
RESERVE
23rd Corps
Moseley's
HARPETH RIVER
WILSON
HATCH
CROXTON
Murfreesboro Bridge
destroyed
COX
STANLEY
RUGER
Depot
Ch.
C.H.
1st Div. 4th Corps
BATTERIES
Charlotte Pike
Mrs. St. Clair
Cemetery
FORT
GRANGER
Pontoons
Bridge destroyed
KIMBALL
3rd Div.
4th Corps
WOOD
Bottom land
To Nashville

when Hood forced him to withdraw to the north bank of the river. On the 28th Schofield learned that Forrest's Confederate cavalry threatened his line of withdrawal through Spring Hill, 11 miles in his rear, and early on the morning of the 29th all his trains and three divisions of infantry were put in motion for Spring Hill. Stanley led, and arrived at Spring Hill just as Forrest reached it. Stanley checked Forrest and took defensive positions. Hood followed Forrest, and during the night Schofield's entire army passed through Spring Hill, in sight of Hood's bivouac fires, for Franklin, 12 miles distant, which the advance reached before daylight of the 30th. Being unable at once to cross to the north bank of the Harpeth River, Schofield, who was closely followed by Hood, had to fight to save his trains, with a river at his back. He threw up a line of entrenchments, and a division of the Fourth corps under Stanley crossed to the north bank of the river, all those remaining in the works south of it being under command of General Cox. By noon the trains were in, and most of them crossed to the north bank. Not anticipating a general attack, Schofield gave orders for the withdrawal of the troops at sunset. He was mistaken as to the intention of Hood, who had closely followed his rear with Forrest's cavalry, and when Wagner's division, acting as Schofield's rear-guard, had halted and thrown up barricades about 280 yards beyond the main line, Hood rapidly advanced his infantry and ordered a desperate assault to drive the Union forces into the river. Two of Wagner's brigades were on either side of the Columbia road; Opdycke's brigade had come into the main line and was massed 200 yards in rear of the entrenchments. Wagner's orders were «to develop the enemy, but not to attempt to fight if threatened by too strong a force.» Hood formed his lines with celerity on either side of the Columbia pike, Cleburne's and Brown's divisions of Cheatham's corps on the east and west sides of the road respectively, in two lines of battle. When within 400 yards of Wagner's line, at 3.30 P.M., the charge was ordered and, with a wild shout, they rushed forward. Wagner was enveloped on both flanks and fiercely attacked in front, the Confederates rushed over his barricades and his men gave way in the greatest disorder, closely pursued by the exultant enemy. When within 100 yards of the main line the Union artillery and infantry opened fire. Cleburne, who was leading his division, was shot dead, great gaps were made in the ranks, but the line pressed on, carried the centre of the 23d corps' line for the length of a brigade, went over the works, captured two batteries and many prisoners, reached an inner line of entrenchments, 68 yards in rear of the main line, and here they were checked. Colonel Opdycke, who had massed his brigade in rear, when he saw Wagner's men falling back in disorder, and that the works in front had been captured, ordered his men forward. Deploying as they advanced, they rushed upon the Confederates, and a desperate hand-to-hand encounter took place, resulting in the retreat of the enemy to the outer line of works, the capture by Opdycke of nearly 400 prisoners and nine battle-flags, and the recovery of the captured batteries. General Thomas says Opdycke's prompt action «saved the day.» Meanwhile the battle had extended to the right and left, involving all of the 23d corps and the left brigade of Kimball's division. The Confederates reached the works in many places, but were unable to carry them. On both sides the fighting was most gallant. At midnight the Union army crossed to the north bank of the river and marched to Nashville.

The Union army engaged at Franklin, not including cavalry, numbered about 23,000 men, of whom 189 were killed, 1,033 wounded and 1,104 missing. Of this loss 1,241 were in Wagner's division. The Confederates engaged numbered about 22,000. There are no complete official reports of Hood's losses; as far as figures are available it appears that the Confederates lost 534 in killed, 1,744 wounded and 417 in missing; but Schofield reports that 1,750 were buried on the field, 3,800 were disabled and placed in hospitals and 702 captured, an aggregate of 6,252, to which must be added the slightly wounded, probably 2,000. A controversy arose regarding the responsibility for the heavy losses of the Union forces which was followed by an investigation, resulting in the censure of General Wagner's actions and in his removal from his command at his own request. On the Confederate side General Hood was blamed by many for his severe losses, and, although his superiors held him blameless, he too was relieved at his own request. Franklin, Tenn., was also the scene of various other actions, engagements and skirmishes fought on 9, 12, 26, 27 Dec. 1862; 1 Feb.; 4, 31 March; 9, 10 April; 4 June 1863; 17 Dec. 1864. Consult Cox, J. D., 'Campaigns of the Civil War: The March to the Sea, Franklin and Nashville' (New York 1882); id., 'The Battle of Franklin, Tenn.' (New York 1897); Hood, J. B., 'Advance and Retreat, etc.' (New Orleans 1880); Johnson, R. U., and Buel, C. C., editors, 'Battles and Leaders of the Civil War' (4 vols., New York 1884–88); Johnston, J. E., 'Narrative of Military Operations, etc.' (New York 1874); Shellenberger, J. K., 'The Battle of Franklin, Tenn., etc.' (Cleveland 1916); Speed, T., 'From Columbia to Franklin' (in *Southern Bivouac*, Vol. III, No. 9, p. 399, Louisville 1885); United States War Department, 'War of the Rebellion. Official Records' (Series I, Vol. XLV, pt. 1; Series III, Vol. V; Atlas; Washington 1891–95); VanHorne, T. B., 'History of the Army of the Cumberland' (2 vols., Cincinnati 1875); id., 'Life of General G. H. Thomas' (New York 1882).

E. A. CARMAN.

FRANKLIN, State of, now Tennessee (q.v.). Twelve years after the Watauga Association was formed (1772), and when four counties west of the present North Carolina had been organized, with some 10,000 people, that State on request of Congress ceded the district to the United States, giving it two years to accept. The inhabitants, already aggrieved at having no Supreme Court or militia protection, and being left to fight the Indians and keep public order without help, and now, feeling abandoned to at least two years' anarchy, decided to revolt, set up a State, and ask Congress for admission. On 23 Aug. 1784 deputies from three counties met at Jonesboro, resolved on measures and issued an address to the people. Each county chose five representatives, which met in convention at Jonesboro in November, but were unable to agree, and adjourned to 14 December. Meantime the alarmed North Carolina legislature established a Supreme Court and proper officers, and formed the Watauga militia into a brigade, commanded by the leader of the revolt, John Sevier. He advised the convention to accept this redress of their grievances; they refused and made him president of their meeting, drew up a constitution to be ratified by another convention the following November, and named the new State perhaps at first Frankland; if so, they soon changed it to Franklin, after the philosopher. A governor — Sevier — and a legislature were elected; courts established, sheriffs and justices appointed, etc. For the next three years there were two conflicting governments, each levying taxes, disallowing each other's official acts and making war on each other. The North Carolina militia invaded the Franklin courthouse at Jonesboro, seized the papers and turned the judge and counsel outdoors; a Franklin mob did the same service to a North Carolina court; the North Carolina commander took the papers by force from Sevier's house, and Sevier gathered a force and recaptured them from his opponent's house. At last, in 1788, the North Carolina party prevailed and put an end to Franklin; Sevier was carried off to Morganton, N. C., put into jail and later tried for high treason. While his trial was going on about a dozen of his followers entered the courtroom. Remaining unrecognized they succeeded in attracting Sevier's attention and, while one of them interrupted the proceedings by addressing the presiding judge, Sevier made good his escape. Finally the North Carolina legislature sensibly passed an act of oblivion and made Sevier a senator, and in 1790 the lands were ceded to the United States. From 1790–96 they were known as the Territory South of the Ohio. In 1796 they became the State of Tennessee with John Sevier as the first governor. (See UNITED STATES — WESTWARD MOVEMENT). Consult Fitch, W. E., 'The Origin, Rise and Downfall of the State of Franklin, etc.' (in *Order of the Founders and Patriots of America, New York Society*, Publication No. 25, New York 1910); Gilmore, J. R., 'The Rear-Guard of the Revolution' (New York 1886); id., 'John Sevier as a Commonwealth-Builder' (New York 1887); Turner, F. M., 'Life of General John Sevier' (New York 1910).

FRANKLIN COLLEGE, a non-sectarian institution founded in 1834 at Franklin, Ind., by the Baptist Church. Its faculty numbers 18; the average annual attendance of students is 260. The tuition fees are $175; living expenses $225; productive funds $333,000; income, including tuition and incidental charges, $53,100. The library contains over 30,000 volumes; the college colors are gold and blue. The number of graduates since organization is 748.

FRANKLIN INSTITUTE, The, of the State of Pennsylvania for the Promotion of the Mechanic Arts, institution founded in Philadelphia in 1824 for the dissemination of knowledge of the arts and sciences. The work of the society is carried on by means of lectures and reports, exhibitions, class instruction, a journal and a reference library. At first the lectures gave systematic courses of instruction, but are now limited to a presentation of the latest discoveries in the arts and sciences. The lectures may be divided into two classes — popular lectures and strictly technical discussions confined to the special divisions of the institute. A committee was formed in 1834 to report on new inventions and discoveries; it consists of 60 members, and its work has greatly enhanced the standing of the institute. The founding of a journal in 1826, by opening the way to the establishment of exchange relations with other societies, proved an invaluable help in promoting its growth. It is issued monthly, gives a record of the institute's work and publishes articles on the advance of science. The institute maintains a library of scientific literature, in some branches unique, and embracing the publications of the principal scientific and technical societies of the world, and the leading periodicals devoted to science and the arts. At the present time the collection consists of about 68,492 volumes and 29,716 pamphlets. Several of the foreign governments have deposited with the library complete sets of their patent-office publications. It contains records of the patent office of Great Britain since 1617, of France since 1791, of Switzerland since 1888, of the United States since 1790. Abstracts of the patents granted by Germany, Russia, Hungary and Austria can also be consulted. The institute has held 29 exhibitions of American manufactures, the most notable being that of 1884, which was the first exhibition in America devoted exclusively to the electrical arts. Medals and premiums are awarded for notable inventions. It maintains a school of architectural and mechanical drawing and night schools of machine designs and naval architecture. Any one interested in the purposes and objects of the institute and expressing a willingness to further the same may become a member when proposed by a member in good standing and elected by the board of managers. The institute fills the need felt by inventors and discoverers of some competent, trustworthy and impartial body, to whom they may safely appeal for advice, and on whose judgment they may confidently rely for an opinion as to the usefulness of their inventions and discoveries. Consult Wahl, W. H., 'Franklin Institute: A Sketch of Its Organization and History' (Philadelphia 1895).

FRANKLIN AND MARSHALL COLLEGE, located at Lancaster, Pa., was formed in 1852 by the consolidation of Franklin College, founded at Lancaster in 1787, and Marshall College, founded at Mercersburg, Pa., in 1836. Franklin College was organized with a view to meet the needs of higher education in the interior of the State, especially among the Germans, who formed so large a part of the population. Dr. Benjamin Franklin, after whom the college was named, took a deep interest in its welfare, contributed liberally to its endowment and in his old age made the journey from Philadelphia to Lancaster to be present at its formal opening. Although the college had in its faculty men like Henry E. Muhlenberg, the distinguished botanist, and Frederick V. Melsheimer, the entomologist, and on its board of trustees some of the most prominent men of the Commonwealth, its work was that of a first class high school.

Marshall College was founded by the Reformed Church in the United States, when its theological seminary was removed from New York to Mercersburg, to meet the educational requirements of her own communion, and with limited resources accomplished a wonderful work. Among the eminent men in its faculty were its first presidents, Drs. Frederick Augustus Rauch and John Williamson Nevin, and later on Dr. Philip Schaff, all of whom took high rank as philosophers and theologians. The college had a brilliant career, but declined for lack of endowment and pecuniary resources.

When the two colleges were united, James Buchanan became president of the new board of trustees, and the institution entered upon a prosperous career, although it had to make its way in the face of many obstacles and limitations. Its growth was checked by the Civil War, from the effects of which it but slowly recovered. During the last 15 or 20 years, however, its growth has been rapid, and it now compares favorably in point of equipment, grade of scholarship and number of students with its sister colleges in the State of Pennsylvania.

Franklin and Marshall College makes no pretense to be a university. It lays stress upon the college course as a means of liberal education, with sufficient elasticity in the way of electives to make first class preparation for technical or professional study. It confers the degrees of A.B. and B.S. for undergraduate work, and A.M. and M.S. for graduate work, after the completion of the prescribed courses and satisfactory examinations.

The site of the college is exceptionally fine. The prncipal buildings are the main building, the halls of the literary societies, the Daniel Scholl Observatory, the gymnasium, two Academy buildings, the De Peyster Library and the new Science building, with admirable equipment for physics, chemistry and biology. The libraries contain altogether about 48,000 volumes. The students in the college proper and the academy number 510, and the faculty 27. This account does not include the Theological Seminary of the Reformed Church, which, although in close proximity to the college, is a separate institution.

FRANKLINISM. See ELECTRICITY.

FRANKLINITE, a native oxide of zinc, manganese and iron, containing these metals in rather widely varying proportions. It crystallizes in the isometric system with octahedral habit, and also occurs in massive and granular forms. It is opaque, slightly magnetic and iron-black in color, commonly with a metallic lustre. Its hardness varies from 5.5 to 6.5, and its specific gravity from 5.07 to 5.22. In the United States its occurs in considerable quantity in the neighborhood of Franklin Furnace, N. J., taking its name from the locality, where it is mined as an ore of zinc, its manganese and iron being melted into «spiegeleisen,» an alloy used in the manufacture of Bessemer steel.

FRANKLIN'S AUTOBIOGRAPHY. Franklin began his autobiography while he was visiting the bishop of Saint Asaph at Twyford in 1771. This first instalment carried the account from 1706, the date of Franklin's birth, to 1731. It was intended solely for his own posterity, and contains what he called «several little family anecdotes of no importance to others,» but the manuscript proved so interesting to some of his friends that he was persuaded, when the Revolution had ended and he again found a little leisure, to continue his task for the sake of the public. At Passy in 1784 he wrote the engaging pages which tell of his early religious speculations and his pursuit of moral perfection. In 1788, once more at home in Philadelphia, he brought his history from 1731 to 1757, and the next year, the year of his death, added a brief section which breaks off, however, without going beyond his initial trials as agent of the Pennsylvania assembly. Part I was issued in French in 1791; Part II, in French in 1798; Part III, in English in 1817 (with I and II); Part IV, in French in 1828. The whole book, as Franklin wrote it, was first published in 1868 by John Bigelow, whose text and notes are indispensable.

Franklin was already a cosmopolite, a great diplomat and statesman, and an honored citizen of the world, when he thus related his small beginnings, but he assumed no posture in presenting himself as he had been when he was only a printer and provincial politician. Nothing can exceed the candor with which he tells of his struggles for a livelihood unless it be the lack of modesty with which he recounts his successes. He is, though he makes no claim to be heroic, actually the hero, in the 'Autobiography,' of one of the few universally interesting plots — that in which a man wins his way unaided. There is something essentially dramatic in Franklin's steady progress to wealth and influence; he had the golden touch which turns every material thing to some human advantage. And yet the book has no romantic coloring. The «family anecdotes» of Part I are neither intimate nor sentimental; the later comments upon style, politics, morals and religion take no higher tone than that of good sense; his noble achievements as scientist and philanthropist are narrated as quietly as the purchase of his first silver spoon. In part, of course, this classic simplicity is due to the fact that he wrote as a richly experienced man, incomparably bland, smooth-tempered, prudent and just; but it is due even more largely to the fact that Franklin was above all the citizen, that he lived most truly when his particular life was most involved in civil affairs. His language is the plain speech of the man who has no private eccentricities of thought or feeling; he instinctively chooses to tell about himself what he knows from his wide knowledge of the world that the world will want to know. The 'Autobiography' is not only one of the greatest of autobiographies; it is one of the most truly republican books ever written.

CARL VAN DOREN.

FRANKMARRIAGE, a species of estate entail once obtaining in England under the common law, but now obsolete. It existed when a man gave land, which he held in fee simple, to his daughter on her marriage, upon which the married couple become donees in frankmarriage, and the land could pass only to their issue of the fourth generation. This estate came into use under Henry II and was a favorite form of dowry until the reign of Elizabeth.

FRANKPLEDGE, the old English custom by which 10 inhabitants of a district made themselves responsible for any crime or injury committed by one of their number. At first only freemen could undertake the frankpledge, but later *villains* were admitted. When a crime was committed by a member the other nine compelled his appearance or held him to reparation. In case he absconded, they themselves were held to make reparation by the sheriff, who held court for this purpose. See CRIMINAL LAW.

FRANKS, SIR **Augustus Wollaston,** English archæologist: b. Geneva, Switzerland, 1826; d. London, 22 May 1897. He was graduated at Cambridge University in 1849; became an assistant in the British Museum in 1851; and served as keeper of the Department of British and Mediæval Antiquities for many years. He was knighted in 1888; and was president of the Society of Antiquities from 1892 till his death. His publications include 'Recent Excavations and Discoveries on the Site of Ancient Carthage' (1860); 'Guide to the Christy Collection of Prehistoric Antiquities and Ethnography' (1868); 'Catalogue of a Collection of Oriental Porcelain and Pottery' (1876), etc.

FRANKS («Spearmen»), **The.** In the 3d century A.D. (the name first appears in 240, under the Emperor Gordian) the scattered Teutonic tribes north and east of the middle and lower Rhine, in the present Westphalia, Hesse, Gelderland, etc., united in a loose confederacy; very probably compacted by the ancestor of the Meroving family, to whom the Franks clung so loyally and even stupidly for centuries. The tribes themselves were known from the early empire: Ampsivarii, Attuarii, Batavi, Bructeri, Chamavii or Gambrivii, Chatti, Cherusci, Sali, Sigambri, Usipetes, etc. In 253 under Valerian they raided Belgic Gaul, and half a century later had permanently settled south of the lower Meuse in Brabant. They are early distinguished as Salian and Ripuarian Franks: the former (from their chief tribe, perhaps originally on the Isala or Yssel) on the lower Rhine; the latter (*ripa*, bank) on both banks of the middle Rhine. The Salians, after heavy defeats by the Romans, became their allies and wardens of the marches; but when the pretender Constantine withdrew the Roman garrisons in 406 for his attempt on Italy, they overran central Belgium, and Colonia Agrippina (Cologne) shortly fell into their hands. By 450 they had reached the Moselle and the Somme, or Luxemburg and northwest France; but still acknowledged Roman sovereignty. They sent forces to help the Romans against Attila at Châlons; but when the Huns had retreated from the fortresses whence they had expelled the Romans,— Trier, Mainz, Metz, etc.— the Franks occupied them and the lands on the Rhine and Moselle instead of the Romans. The Salians now held the territory from the Scheldt to the Somme and Meuse, or most of Belgium and a little of France; the Ripuarians from the Meuse to the Rhine, and the lands along that river from the Lippe to the Lahn. They were still pagans; backward in the arts of war; had no political union or common head, though their chiefs all claimed Meroving descent; and were accused of being treacherous and perfidious even beyond barbarian wont, which their history makes probable.

When the Western Empire fell, the Rhone and Saône valleys were occupied by a Burgundian kingdom; central and northern France by a Roman province in a condition of anarchy; below which was the great Visigothic kingdom of Enric, taking in South France and nearly all the Spanish Peninsula. Five years later (481) a Salian prince of the upper Scheldt named Chlodovech (Latinized Clovis) acceded, and in 485 fell on the Roman province in alliance with other princelings. In three years he had conquered it, making Gaul to the Loire and Brittany a Frankish possession; refusing to share the spoil with his allies, he attacked and subjugated all the Ripuarians, slaying every Merovingian prince he could seize, in order to exterminate all rivals. In 492 he married Clotilda, the Catholic niece of the Burgundian king. In 496 he subdued the Alemanni, and Frankish settlers founded Franconia. On returning from his campaign he was baptized a Christian and subscribed to the Athanasian creed; and in a single generation the entire Frankish body, now consolidated into one, renounced paganism. He then conquered nearly all Visigothic Gaul. But Burgundy was too strong for him. He died in 511. The chance of Chlodovech becoming an Athanasian instead of an Arian had the most important consequences: alone of all the barbarian conquerors of Rome, his subjects were in religious sympathy with him, and his work endured, while the Arian kingdoms crumbled to pieces. This also began the career of the Frankish monarchy, which for centuries, as the champion of the Church, helped it and was helped by it.

Chlodovech began the practice of dividing the kingdom among his sons, which his successors followed; again and again death or the strong hand united the realms, again a legacy would divide them; and the records of the ferocious, half decrepit, perfidious Merovingians are the blackest in all European history for unredeemed wickedness and anarchy. Scarce one of them for a century lived to be 40, and scarce one showed any gleam of statesmanship to justify his atrocities or his even worse weakness. At last in 613 the dominions — which had generally followed the fourfold divisions of Austrasia, Neustria, Burgundy and Aquitaine — were united apparently finally, but the Merovingian kings ceased to have any but a nominal sovereignty. The great provincial governors, in the period of anarchy, had made their offices hereditary; the officers of state likewise — chamberlain, keeper of the seal, etc. Of these the mayors of the palace became the *de facto* rulers; keeping the kings as puppets, but making them live as country gentlemen, only attending court functions annually, in a farm-cart and with long hair. This mayoralty in Austrasia fell into the hands of one of the most wonderful families of the world, the Karlings or Carlovingians, who held possession of it for a century, till one of them became king; and later the mightiest of them, Charlemagne, became emperor of the Romans in a revived empire. Pepin, or Pippin of Landen, «the Elder,» was the first, dying 639; then his son Grimwald, murdered 656; the latter's sister married the son of Arnulf, bishop of Metz; and their son was Pepin the Younger or Pepin of Heristal, who, after 30 years of anarchy and partition and reunion following Grimwald's death, finally and forever reunited the Frankish realms by a crushing defeat of the allied forces of Neustria and Burgundy at the battle of Testry, 687. His son, Charles Martel (Hammer), who held power 717–41, carried civilization at the sword's point among the Germans, and in 732 routed a great Saracen army at Poitiers, saving France from the Mussulman. His son Pepin the Short, after 10 years of mayoralty, deposed the last driveling Meroving and ascended the throne. Pepin's son Charles (Carolus Magnus, Charlemagne, perhaps with a confusion of the title with the name Carloman), acceded in 768. As warrior, statesman and lawgiver, he stands among the foremost of all time. The Frankish realm as such attained by far its greatest extension under him — though it is incorrect to say, as is usual, that his work perished with him, for the territorial divisions of his realm never went back to their old anarchy. He ruled a vast congeries of races, from North Spain to North Germany, and from the Hungarian plains to the English Channel; and he brought them all under the reign of law and Christianity, inheritors of the memories and civilization of Rome. In 800 he crowned the career of the Franks begun by Clovis, becoming secular head of a Holy Roman Empire, of which the Pope was the spiritual head. Whether it was well judged or beneficial to the world, historians are still divided. The history of Charlemagne's successors is not the history of the Franks: after this they became merged in a wider aggregation.

The Frankish dominion was the conduit through which the treasures of Rome, political, social and ecclesiastical, were given to the world. Roman law, Roman literature and the Christian religion were forced on the barbarians through the Franks: their impress, deep and strong, was laid in the foundations of European civilization. The best modern compendium is Oman's 'History of the Dark Ages' (London 1901). Consult also Emerton, 'Introduction to the Study of the Middle Ages' (Boston 1895); Hodgkin, 'Italy and Her Invaders' (8 vols., Oxford 1890–99); Sergeant, 'The Franks' (New York 1898).

FRANSECKY, frăns'kē, **Eduard Friedrich von,** German general: b. Gedern, Hesse, 1807; d. 1890. In 1825 he entered the Prussian army and became a member of the general staff in 1843. He distinguished himself in the war with Denmark in 1848, and by his resistance against seemingly overwhelming odds won a decisive engagement at Münchengratz in the Austro-Prussian War of 1866. He was also prominent in the battle of Sadowa. In 1870–71 in the war against France he commanded the Second Army Corps, and by a forced march reached the battlefield of Gravelotte where he threw the First army against the Pont-du-Jour Heights. Late in the year while commanding the army between the Marne and the Seine he repulsed the great effort of Ducrot's forces to break this line. He was transferred to the East and assisted in the operations which obliged Bourbaki's army to retreat and be interned in Switzerland. He was decorated with the Order of the Black Eagle and received $450,000 marks in recognition of his distinguished services. In 1879 he became governor of Berlin. He resigned this post in 1882. Consult Von Bremen, 'Memoirs of Friedrich von Fransecky' (Bielefeld 1901).

FRANTZ, Konstantin, German publicist: b. Halberstadt, 1817; d. 1891. He was educated at the universities of Halle and Berlin. For some time he studied and wrote on mathematics and philosophy, and also acted as private secretary in the Berlin Foreign Office. He entered the consular service and spent the years 1853–56 in this service in Spain. His work is interesting in view of subsequent events. Russia he believed to be the greatest menace to his country and Europe and after Russia the United States, with its free institutions, and its utter disregard for rockbound political theories. The central idea in his works, therefore, is the necessity of establishing a confederation of central European powers directed against the United States and Russia this confederation to be built around Austria and Germany. His chief works are 'Der Föderelismus als das leitende Princip für die soziale, staatliche und internationale Organization' (1879); 'Die Weltpolitik' (1882–83); and part of Schuchardt's 'Die deutsche Politik der Zukunft' (1899). Consult Schuchardt, 'Frantz, Deutschlands wahrer Realpolitiker' (Melsungen 1896).

FRANZ, Robert, German composer: b. Halle, 28 June 1815; d. Berlin, 24 Oct. 1892. The family name originally Knauth, was legally changed to Franz in 1847. He began the study of music at an early age and in opposition to his parents. At the age of 20 he went to Dessau where he studied under Schneider 1835–37. Upon his return to Halle he studied the great masters, paying special attention to Bach, Handel and Schubert, and in 1843 published his first set of 12 songs, which won the warm praises of Schumann, Mendelssohn, Liszt and other masters. From then till 1868 he held various appointments at Halle. In that year owing to ill health and deafness, he was obliged to give up his positions, and was soon reduced to poverty. A series of benefits were organized by his friends in America and Germany and alleviated his dependency. His arrangements of some of Bach's and Handel's works are standard, but it is as a song writer that he is best known and his fame assured. He published over 250 songs with pianoforte accompaniments, a Kyrie and several chorales and four-part songs, besides arrangements of the vocal masterpieces of Bach and Handel. Franz's best songs rank with those of Schubert and Schumann. Consult Prochaska, 'Robert Franz' (Leipzig 1894).

FRANZ, Shepherd Ivory, American psychologist: b. Jersey City, N. J., 27 May 1874. He was graduated at Columbia University in 1894, and later studied at the University of Leipzig. In 1897–99 he was assistant in psychology at Columbia, was assistant in physiology at Harvard 1899–1901, instructor in physiology at Dartmouth Medical School 1901–04, pathological psychologist at the McLean Hospital, Waverley, Mass., 1904–06. In 1906 he became professor of experimental psychology and physiology at George Washington University, in 1907 psychologist and in 1910 scientific director in the same institution. He is a Fellow of the American Association for the Advancement of Science and member of many other learned bodies. He is author of about 70 monographs and articles on psychology, neurology and psychopathology, including the volume 'Handbook of Mental Examination Methods' (1912).

FRANZ-DREBER, frănts' drā'bĕr. See Dreber, Heinrich Franz.

FRANZ-JOSEF LAND, frănts'-yō'zĕf-länt, an Arctic archipelago, north of Nova Zembla, extending, so far as it has yet been explored, between latitude 80° and 83° N. It consists of about 100 small islands divided by fjords, channels and sounds. The chief islands are Alexander in the west, Graham Bell in the east, Wilezek, Prince George, Prince Rudolph in the north, Cape Fligely and Northbrook. The whole archipelago, which rises into isolated flat-topped or dome-shaped mountains of basalt, 5,000 feet high, is sheeted with ice. The islands are of volcanic origin and are composed mostly of Juranic basalt. Fossil strata are numerous. The winter sun is absent four months, and the climate is in consequence distinctly polar. Auroral displays are on a magnificent scale. The average temperature in winter is about — 19° F., and in summer 35° F. There are dense fogs and violent gales often continued for days. The chief plants are lichens, and grasses, and yellow and white poppy, and cresses. The mosses form thick carpets in places with a brilliant coloring. There is a comparative abundance of animal life — bears, walruses and foxes occurring, also ringed seals. Of birds are found the snow bunting, eider duck, purple sandpiper, various gulls, guillenots, the little auk, brant goose, snowy owl and Arctic tern. Of insects there are only six species. The archipelago was discovered and partly explored by Payer and Weyprecht in 1873–74; its southern shores were explored by Leigh Smith in 1880–82, and much of it by the Jackson-Harmsworth expedition in 1895–96; also by Nansen in his retreat 1896; Wellman in 1898 and 1900; by the Duke of the Abruzzi 1899–1900, in which Cagni made the then world's record of 86° 33'; by Baldwin-Zeigler in 1901–02; and by the Fiala-Ziegler Expedition in 1903–05. (See Polar Research). Consult Duke of the Abruzzi, 'On the Polar Star in the Arctic Sea' (2 vols., New York 1903); Greely, 'Handbook of Polar Discoveries' (Boston 1911); Jackson, 'A Thousand Days in the Arctic' (New York 1899); Payer, 'New Lands Within the Arctic Circle' (Eng. trans., London 1876); Peters, 'Ziegler Polar Expedition, Scientific Results' (Washington 1907); Weyprecht, 'Sulla spedizione polare austro-ungarica' (Trieste 1875).

FRANZEN, August, American portrait and genre painter: b. Norrköping, Sweden, 1863. He came to America while still a boy, and went to Paris where he studied under Dagnan-Bouveret. There he carefully prepared himself for the careful and conscientious work as a portraitist which has filled so great a part of his artistic career. He settled in New York and became a member of the Society of Amercan Artists in 1894, and an associate of the National Academy in 1906. He has painted many celebrities and his exhibitions are largely attended. He was awarded a medal at the Chicago Exposition of 1893, and a bronze medal at the Paris Exposition of 1900. His 'Yellow Jessamine' hangs in the Brooklyn Institute Museum.

FRANZENSBAD, frănt'sĕns-bät, **EGER-BRUNNEN,** ā'gĕrbroon-nĕn, or **KAISER-FRANZENSBAD,** Bohemia, a celebrated Austrian watering-place, about four miles northwest of Eger, with which it is connected by a fine avenue. It is situated amid low, bare hills, and consists of four rectangular streets lined with trees. The mineral springs here were known in the 16th century, and even at that time the waters were bottled and sent to a distance. It was selected as a watering-place in 1793 by the Emperor Frances II (of Germany — Francis I of Austria), from whom it received its present name. The bathing establishment consists of an irregular building erected over the springs with a long colonnade extending to the Kurhaus, where the visitors assemble, and the balls and concerts are given. The springs, 12 in number, are alkaline, saline, chalybeate, and are very efficacious in cases of anæmia, dyspepsia, etc. The mud baths of Franzensbad are much used by those suffering from gout, rheumatism, skin diseases, etc.

FRANZENSKANAL, frănts'ens-kä-näl', or **BÁCSER CANAL,** canal of Hungary, constructed in 1801, connecting the Danube from a point about 20 miles south of Mohacs with the Theiss at a point about the same distance south of Zenta, and passing through Zombor and Kula. About midway between these cities a branch canal leaves it and goes southeast to the Danube at Veusatz. The main canal is 65 miles long, 65 feet wide and 6½ feet deep. The branch line is 35 miles long and of equal depth and width.

FRANZOS, frăn-tsōs', **Karl Emil,** Austrian author: b. Russian government of Podolia, 1848; d. 1904. His early days were spent in the place described in his stories. After passing state examination in law, he became a journalist and traveled, 1872–76, through Europe, Russia, the Danubian lands, Turkey and Egypt, settling in 1876 in Vienna where he wrote three famous books that have been translated into many languages: 'Halb Asien,' 'Vom Dom zu Donau' and 'Aus der Grossen Ebene.' From 1882–85 he edited the *Neue Illustrirte Zeitung*, and in 1880 founded and edited the *Deutsche Dichtung*, moving to Berlin in 1887. Stressing rather the tragic sides of Jewish life among the Galician Jews, he wrote 'Die Juden von Barnow' (1877); 'Moschko von Parmo' (1880); 'Judith Trachtenberg' (1881), which have appeared in numerous editions and languages. His 'Ein Kampf ums Recht' (1887) is broader in vein, dealing with farmer's rights in Bukowina. He was the author of many other works in fiction and biography, and his books have been widely translated. His wife, Ottilie Benedict (b. Vienna, 24 Sept. 1856), wrote 'Das Adoptiv Kind und Andere Novellen' (1890), and 'Schweigen' (1902).

FRAPAN (fră'pän) **ILSE,** the pseudonym of the German novelist and poet Ilse Levien (q.v.).

FRAPOLLI, fră'pōl-lē, **Lodovico,** Italian diplomat and patriot: b. Milan, 1815; d. 1878.

He was forced to join the Austrian army in 1831, but left it in 1836. He went to Paris in 1840 to study at the School of Mines. His works deal principally with the origin of the earth, its formation, etc., the geological formation of Germany, Scandinavia, etc., in which countries he traveled extensively in 1843–47. He was for some time secretary of the French Geological Society. During the revolutionary year of 1848 he fought at Paris and subsequently was made War Minister of the Lombardy government. He returned to France as Ambassador of Lombardy, and later of Tuscany and the Roman republic. After the capture of Rome, he lived in succession in Switzerland, Sardinia and France. In 1860 he joined Garibaldi's forces in Sicily and entered Naples with him. He was an Italian deputy from 1860 to 1874, and was an extreme member of the Republican party. He was prominent in Masonic circles. In 1870 he fought with Garibaldi in France. He died in a sanitarium, after a lingering illness.

FRAS, or FRAZ, Jacob. See VRAZ, STANKO.

FRASCATI, fras-kä'tē, Italy, summer resort in the province of Rome, on the north side of the Alban Mountains, 15 miles southeast of Rome. It is the see of a cardinal bishop and contains two churches over 11 centuries old. There is a memorial tablet in the church of San Pietro, to Charles Edward Stuart, the Young Pretender, whose body was buried here in 1788, but is now in Saint Peter's, Rome. Frascati contains many famous estates or villas, the more notable of which are the Villa Torlonia, formerly Conti; the Villa Lancelotti, formerly Piccolomini, where Cardinal Baronius composed his 'Church History' in the 16th century; the Villa Aldobrandini, in which are paintings by the Cavaliere d'Arpino; the Villa Ruffinella, once owned by Lucien Bonaparte and later by Victor Emmanuel II. For the robbery of Lucien Bonaparte at this villa see Irving's 'Adventure of an Artist.' In the neighborhood are the ruins of an amphitheatre, the villa of Cicero, a Roman theatre and reservoir. The city is famous for its wine. Pop. 10,577. Consult Ashby, T., 'Papers of the British School at Rome' (Vol. IV, London 1907).

FRASCH, fräsh, **Herman,** American chemist and inventor: b. Gaildorf, Wurttemberg, Germany, 1852; d. 1914. He began the practice of pharmacy in 1868, and after his arrival in the United States entered the laboratory of Professor Maisch at the Philadelphia College of Pharmacy. In 1874 he established his own laboratory. Many of his earlier inventions were connected with the production of oil, salt, wax and white lead. In 1885 he entered the petroleum refining business on his own account in London, Ontario; here he devoted himself so successfully to the refining and purification of Canadian oils that his product, the highest grade of pure oil, became a serious competitor to Pennsylvania oil. The patents and works were purchased in 1888 by the Standard Oil Company and the processes were put into practice at the various plants of this company throughout the United States. Further patents for the treatment of petroleum and petroleum products were issued to Mr. Frasch. In 1890 he took a patent on an apparatus that is regarded as an epoch-making improvement in the sulphur industry. He erected a plant at the deposits of native sulphur in Louisiana and by sending down superheated water through a boring of 1,000 feet he melted the sulphur, which then ascended to the surface through an inner tube in the boring. The melted sulphur is then pumped into bins several feet high, in which it solidifies, and the blocks are later broken up and loaded directly on cars. The result of this invention has been a reduction of the importation of sulphur into the United States to less than one-tenth of its former proportions, and a corresponding increase in home production. Frasch was awarded the Perkin medal in 1912.

FRASER, Alexander, Canadian Gaelic scholar and author: b. Inverness-shire, Scotland, 1860. He was educated at Perth and at Glasgow University. He came to Canada in 1886, entered journalism, became city editor of the Toronto *Mail* and later of the Toronto *Mail and Empire*. He also edited successively the *Scottish-Canadian*, the *Presbyterian Review* and *Fraser's Scottish Annual*. He was lecturer in Gaelic at Knox College, Toronto, for many years and delivered the annual Gaelic address before the Gaelic Society at Inverness, Scotland, in 1895. He was elected president of the Gaelic Society of Canada and of the Canadian Folklore Society, and in 1906 became archivist of the province of Ontario. His works include 'Short Scottish-Canadian Biographies'; 'Essays on Celtic Literature'; 'Practical Lessons in Gaelic Grammar'; 'The Mission of the Scot in Canada'; 'The Last Laird of MacNab' (1899); 'The 48th Highlanders of Toronto' (1900); 'The History of Ontario' (1907); 'The Brock Centenary 1812–1912' (1913).

FRASER, Alexander Campbell, Scottish philosophical writer: b. Ardchattan, Argyleshire, 3 Sept. 1819; d. 2 Dec. 1914. He was a lecturer on mental philosophy in the New College, Edinburgh, 1846–56, editor of the *North British Review*, 1850–57; and professor of logic in Edinburgh University, 1856–91. His principal productions are 'Essays in Philosophy' (1856); 'Rational Philosophy' (1858); a memoir of Bishop Berkeley, with a collected edition of his works (1871–90); an annoted edition of Locke's 'Essay on the Human Understanding' (1894); 'Philosophy of Theism' (1898); a valuable personal retrospect entitled 'Biographia Philosophica' (1904); 'Berkeley and Spiritual Realism,' (1909), etc.

FRASER, Charles, American painter: b. Charleston, S. C., 20 Aug. 1782; d. there, 5 Oct. 1860. He studied law, was admitted to the bar in 1807, but withdrew from practice in 1818, and acquired, particularly in the South, a considerable reputation as a miniature-painter. His sitters included Lafayette (1825) and most prominent South Carolinians for 50 years. He also painted interiors, landscapes, genre and still-life scenes, and historic subjects. An exhibition of his works at Charleston in 1857 comprised 313 miniatures and 139 other canvases in oils. Publication 'Reminiscences of Charleston' (1854).

FRASER, Mrs. Hugh. See FRASER, MARY.

FRASER, James, English prelate: b. Prestbury, Gloucestershire, 18 Aug. 1818; d. Manchester, 22 Oct. 1885. He was educated at Lincoln College, Oxford, took orders in the English Church and was rector at Cholderton, Wiltshire, 1847–60; and of Upton Nervet, Berkshire, 1860–70. He was made assistant commissioner of education in 1858 and in the following year rendered a memorable report on his division. In 1870, soon after his refusal of the bishopric of Calcutta, he became bishop of Manchester, in which position he gained the approbation of churchmen and non-conformists alike, as also other religious denominations, which earned him the sobriquet of "bishop of all denominations." Under his administration the diocese made a most remarkable advance. He opposed the Tractarian movement and belonged to the old High Church school of theology. Bishop Fraser was greatly interested in educational matters and visited the United States and Canada in 1865 as a commissioner of education, subsequently publishing a 'Report on the Common School System of the United States and of Upper and Lower Canada' (1866). A bronze statue of Bishop Fraser stands in the square before the town hall of Manchester, and in the Fraser Chapel of the cathedral of Manchester is a recumbent statue in marble of the much-beloved prelate. He published some addresses and sermons and various reports as commissioner of education. Consult Bryce, 'Studies in Contemporary Biography' (New York 1903); Diggle, 'The Lancashire Life of Bishop Fraser' (3d ed., London 1889); id., 'Sermons of Bishop Fraser' (1887–88); and 'Memoir of Bishop Fraser' (1887).

FRASER, Mary (Mrs. Hugh Fraser), English novelist: b. Rome. She is a sister of F. M. Crawford (q.v.), the novelist, and was married to Hugh Fraser, English Minister to Japan, who died in 1894. She traveled with her husband in America and the Orient and in 1884 embraced the Roman Catholic faith. In her works she seeks to interpret the spirit of the new Japan. She is the author of 'The Brown Ambassador' (1895); 'Palladia' (1896); 'A Chapter of Accidents' (1897); 'The Looms of Time' (1898); 'A Diplomatist's Wife in Japan' (1899; new ed., 1911); 'The Custom of the Country; or Tales of New Japan' (1899); 'The Splendid Porsenna' (1899), a story of modern Roman society. She published also 'Letters from Japan' (1904); 'A Diplomat's Wife in Many Lands' (1910); 'Further Reminiscences' (1912); 'The Honor of the House,' with J. J. Stahlman (1913); 'Italian Yesterdays' (1914); 'The Bale Fire' (1914); 'Captain Corbeau's Adventure' (1914); 'Seven Years on the Pacific Slope' (1915).

FRASER, Simon. See Lovat, Twelfth Lord.

FRASER, Sir Thomas Richard, English physician: b. Calcutta, 5 Feb. 1841. He was educated at Edinburgh University in 1862 and was assistant physician to the Royal Infirmary 1869–74. He became examiner in materia medica 1870–75, and in public health 1876–79 in the University of London. In 1877 he was a member of the Admiralty committee on Sir George Nares' Arctic Expedition 1877, in which year he became professor of materia medica at Edinburgh and of clinical medicine in the following year. He was dean of medicine at Edinburgh from 1880 to 1900, was president of the Indian Plague Commission 1898–1901, president of the Royal College of Physicians of Edinburgh 1900–02. In 1902 he was knighted. He is well known as an authority on poisons and has published 'An Investigation into Some Previously Undescribed Tetanic Symptoms Produced in Cold-blooded Animals' (1867–68); 'An Experimental Research on the Antagonism between the Action of Physostigma and Atropia' (1870); 'The Character, Action, and Therapeutic Uses of Physostigma' (1883), and 'Duspnœa of Bronchitis and Asthma' (1887).

FRASER, William Alexander, Canadian author: b. Picton County, N. S., 24 March 1859. He traveled widely and became a mining engineer, but subsequently turned his attention to writing. He has contributed much to English and American magazines and has achieved distinction as a writer of short stories. 'The Eye of a God and Other Stories' first attracted attention (1892); and he published in 1900 an interesting collection of animal stories, 'Mooswa and Others of the Boundaries.' Other works are 'The Outcasts' (1901); 'Thoroughbreds' (1902); 'Brave Hearts' (1904); 'Sa'zada Tales' (1906); 'The Lone Furrow' (1907).

FRASER RIVER, the principal river in British Columbia. The larger fork of the Fraser rises in lakes in lat. 55° N. and long. 124° W. After flowing southeast for about 160 miles it joins the lesser fork, which has a length of 200 miles from its source in the Rockies to the junction. The main stream flows through the province from north to south for 725 miles and enters the Gulf of Georgia a little north of the United States boundary line. The Fraser receives the waters of the Stuart, Quesnelle, Blackwater, Thomson, Chilcotin and of many lesser streams. It is navigable for 100 miles in its lower course and in a part of the upper course between Fort George Cañon and Soda Creek vessels of light draft navigate the stream. It is subject to floods from April to August, often rising 60 feet above normal high water in the narrow reaches and covering about 200,000 acres in the valleys lower down. Gold was discovered in its bed in 1857 and for some years the rush thither rivalled those of California and Australia. Its lower watershed is densely forested. Great quantities of timber are floated down the river and its tributaries. The salmon, of which there are five species, are world famous, and the fishing and canning industries are of some importance. The river was named after Simon Fraser, who explored it in 1808.

FRASER RIVER SALMON and others of the genus *Oncorhynchus nerka,* the blueback, redfish, which are common in the Fraser River and other streams of British Columbia.

FRASERBURGH, Scotland, seaport in Aberdeenshire, 42 miles north of Aberdeen. It contains a handsome cross, town hall, large custom-house; the streets are wide and clean. In the neighborhood to the north is the Promontorium Tœxalium of Ptolemy, now Kinnaird Head, on which stands Fraser's ancient castle, utilized as a lighthouse, with its mysterious wine tower and cave. Fraserburgh is the chief centre of the Scottish herring fishery, and in addition to cured herrings and cod, exports barley, meal, oats and potatoes. It has three tidal harbors, and its shipping includes 14 sailing vessels, 8 steam vessels and a fleet of 700 fishing boats. The herring trade is valued at $1,000,000 annually. Pop. 11,151. There is a large increase in the number of inhabitants during the fishing season (July and August).

FRASERVILLE, or **RIVIÈRE DU LOUP,** rē-vyār' dü loo, Canada, a town and county-seat of Temiscouata County, Quebec, on the south shore of the Saint Lawrence at the confluence of the Rivière du Loup, 116 miles below Quebec. It is on the Intercolonial Railway and is the terminus of the Temiscouata Railway. Its permanent population is almost entirely French Canadian. It has railway workshops, and manufactories of pulp, leather, lumber, furniture, iron products, butter and flour. It is a popular summer resort. Pop. 6,774.

FRATERNAL INSURANCE. See INSURANCE, FRATERNAL.

FRATERNAL SOCIETIES IN AMERICA. A fraternal society is defined as a corporation or voluntary association organized and carried on for the sole benefit of its members and their beneficiaries. It has no capital stock and is not operated for profit. Every such society must have a representative form of government, and is supposed to operate on the lodge system, with a ritualistic form of work for the meetings of the lodges or other designated subordinate bodies. It has power to adopt its own constitution, by-laws, rules and regulations for the orderly conduct of its affairs, and in general terms may manage its internal interests as it may deem best. Although the American fraternities have the same basis as the friendly societies (q.v.) of England and Scotland, they are a purely American institution, organized without reference to, and at the outset of their career, in entire ignorance of the fact that the same system was in successful operation elsewhere. At the present time the laws governing the fraternal system are in a state of transition, and as the fraternal societies are the creatures of, and governed by the laws of, the different States, any change in those laws will necessarily change or modify the system as at present operated.

There are two representative bodies, claiming to act for, and represent a large constituency among the fraternal associations. The National Fraternal Congress, organized in 1886, represents the larger number of leading societies. From its official reports it appears to aim at eventually securing the adoption of a uniform law throughout the United States and Canada, defining as fraternal society, as above expressed, with the addition, that every society shall pay a death benefit on the death of a member, and may pay disability payments, resulting from accident, disease or old age. During the years 1900 and 1901 the Congress made a vigorous effort to secure the passage of a uniform bill in the legislatures in all the leading States, restricting the benefits, coupled with a provision requiring all the newer organizations to charge adequate rates, but allowing the older societies to continue their low rate assessment system. This action was bitterly opposed by the minority of the Congress and by a still larger number of other associations that were not affiliated with the Congress. The result of this opposition was the defeat of the proposed law in every State where a contest was made.

The outside societies that participated in this contest, feeling the need of a union for mutual protection thereafter, immediately after the contest was ended met together and in March 1901 organized the Associated Fraternities of America, with the avowed object of opposing any further changes in the laws of the different States until public sentiment was ripe for the adoption of a uniform law on the basis of the largest liberty to each society in the matter of benefits, provided adequate rates are charged therefor. This dissension among the fraternal societies induced the convention of the insurance commissioners of the different States to formulate a proposed law for the government of fraternal societies, containing many new and startling features.

All the early fraternal associations collected their contributions from their members by means of assessments, the rate of which, except in two instances, was graded according to age at entry, and each member was required to pay such a number of assessments each month as might be needed to meet the death losses. As these older organizations advanced in years, their death losses necessarily increased in number, and with increased death losses the number of assessments each month also increased. During this period many new societies were organized on the same system and while young naturally had a low death rate and a low mortality cost per member. Being much cheaper they naturally attracted members from their predecessors until they were displaced in popular favor by other new creations on the same plan. Whatever differences of opinion may now exist among fraternalists as to the need of the systems at the present time, they all agree that the old assessment system has been a failure, and should be superseded by rates based on the recognized mortality tables. The newer organizations profited by the experience of the older societies, and generally started with higher rates, and this fact has made it much easier for them to provide for their deficiencies. A large number of the younger organizations are, and for some years have been, charging adequate rates, and the protection they furnish is as safe as the insurance supplied by any insurance company.

The real basis of the fraternal system in America is the fraternal bond of union, uniting the members together in a common cause for mutual beneficial and protective purposes. The lodge system requires meetings of the members at least once a month, and therefore directly tends to draw the members closer together. Every member thus participates in the work of the organization and the emulations aroused among the different lodges naturally produces the best results at the least outlay. Bread cast upon the waters will return, and it is the act of casting that produces that wonderful change in the human heart, which constitutes the return. A mother is fonder of her offspring than the father, and both parents love a crippled child more than the sturdy members of the flock, and the reason is the same. The mother suffers more and bears more than the father, and both do more for the cripple than for the healthy child. No one ever did a good deed, or thought to do a good act without feeling the better for it, and thus no person ever did or can participate in the good work that the various lodges of the fraternities are engaged in without growing to love the work and the organization which does the work. This ennobling influence upon the membership is not by any means the least of the many blessings conferred upon the American people by the fraternal system. This same influence naturally impels the members to labor without compensation for the growth and prosperity of the organization and thus at a low cost produce results beyond the dreams of avarice to the insurance companies.

Every society is required to have a representative form of government and is governed by its constitution and laws, as enacted, or from time to time amended by the constituted authorities. Its constitution and laws therefore constitute the contract between the members in their relations to the society. The protection furnished by such societies is not insurance in the ordinary sense in which that word is understood and used. No society can issue a certificate in favor of a creditor of the member and the benefits furnished under the certificate cannot be attached for the debt of the member. The beneficiaries are limited to husband or wife, affianced husband, or affianced wife, or some heir, blood relative or dependent of the member. In insurance anyone having an insurable interest in the life of the policy holder may be named as beneficiary while under a fraternal certificate the beneficiary is limited by the bonds of affection and duty. In the one case a beneficiary has a vested interest in the policy and it cannot be changed without her consent, while in the other the beneficiary has no vested rights whatever until the claim matures; and the member may have his certificate changed in favor of another beneficiary without her knowledge or consent.

There are numerous other societies conducted on the same principle. According to the reports of the supreme bodies of these organizations for 1916 the membership of the principal fraternal organizations in the United States and Canada was as follows, beginning with the largest:

Freemasons	1,760,277
Odd Fellows	1,622,100
Modern Woodmen of America	921,899
Eastern Star, Order of	800,000
Woodmen of the World	732,385
Knight of Pythias	729,053
Rechabites, Independent Order of	701,040
Good Templars, International Order	620,000
Loyal Order of Moose	620,000
Improved Order of Redmen	479,033
Benevolent and Protective Order of Elks	442,658
Royal Arch Masons	422,359
Order of Eagles	400,000
Ancient Order of United Workmen	350,000
Knights of Columbus	346,560
Order of Owls	346,754
The Maccabees	331,756
Ancient Order of Hibernians	250,000
Royal Arcanum	244,722
Knights Templar	237,368
Independent Order of Foresters	218,074
Junior Order of United American Mechanics	230,000
Nobles of the Mystic Shrine	220,000
Foresters of America	205,756
B'rith Abraham Order	194,490
Brotherhood of American Yeomen	196,478
Woman's Benefit Association of the Maccabees	179,176
Knights and Ladies of Security	155,399
Ladies' Catholic Benevolent Association	155,080
Loyal Orange Institution	150,000
Tribe of Ben Hur	101,011
Orioles, Order of	98,781
Sons and Daughters of Liberty	90,265
Protected Home Circle	88,252
Fraternal Aid Union	80,000
Mystic Workers of the World	83,538
Knights of the Golden Eagle	78,112
Court of Honor	75,786
United Commercial Travelers of America	72,964
Order of Gleaners	71,070
Daughters of America	68,000
Improved Order of Heptasophs	65,604
Knights and Ladies of Honor	65,855
Catholic Mutual Benefit Association	64,615
National Union	62,028
New England Order of Protection	53,619
Hermann's Sons	42,000
Ladies of the Modern Maccabees	50,088
Independent Order of B'nai B'rith	40,083
Knights of Malta	40,000
United Order of American Mechanics	36,316
Patriotic and Protective Order of Stags	34,827
Veiled Prophets of the Enchanted Realm	34,000
Fraternal Brotherhood	26,495
Royal League	32,756
Sons of Saint George	32,000
Order of United Ancient Druids	30,968
Smaller organizations	236,841
Total	16,118,931

All the older associations operate on what is known as grand jurisdictions consisting of representatives elected by the subordinate lodges within the limits of the grand jurisdiction. It in turn sends delegates to the supreme body, which is the highest authority in the organization. As a general rule the supreme body assumes all liability for death or disability payments that are permanent in their nature, and the subordinate lodges assume and pay the sick or other temporary disability benefits. Each member pays his share of all benefits through the local lodge, of which he is a member, the dues going to the supreme office, being remitted direct, and not through the grand jurisdiction. As a rule the grand jurisdiction covers a State, and has supervision over the growth and general management of all the lodges within its territory. Of late years the tendency has been to do away with the plan of grand jurisdictions and have the supreme body composed of delegates elected either directly by the lodges or by districts composed of a number of lodges. The officers are usually elected by the supreme body, but in some cases are elected by a direct vote of the members.

To sum up in a word: a fraternal society is a brotherhood of members, bound together by its fraternal bond of union. It is organized and carried on for the sole benefit of its members and their beneficiaries. It operates on the lodge system, and uses a ritual in the meetings of its lodges and the initiation of its new members. It has a representative form of government, in which the management is responsible to the members for the faithful performance of their duties. It is governed by a constitution and laws enacted by the representatives of its members, and it furnishes its members, in all the States, with protection in case of death, and in many of the States with protection in case of disability resulting from illness, accident and old age after the expectancy of life, and in some of the States with still more liberal benefits. See INSURANCE, FRATERNAL, and the articles on the different fraternal organizations.

FRATERNITIES, religious societies for pious practices and benevolent objects. They were often formed during the Middle Ages, from a desire of imitating the holy orders. From the 12th to the 15th century nothing was considered more meritorious than to form and belong to such orders. The laity, who did not wish to pronounce the monastic vows, entered into associations in order to gain some of the advantages of the religious even in their worldly life. These societies were at first formed without any ecclesiastical interference, and on this account many of them, which did not obtain or did not seek the acknowledgment of the Church, had the appearance of separatists, which subjected them to the charge of heresy. The pious fraternities which were formed under the direction of the Church or were acknowledged by it were either required by their rules to afford assistance to travelers, to the unfortunate, the distressed, the sick and the deserted, on account of the inefficiency of the police, and the want of institutions for the poor, or to perform certain acts of penitence and devotion. Of this description were the Fratres Pontifices, a brotherhood that originated in Tuscany in the 12th century, where they maintained establishments on the banks of the Arno, to enable travelers to cross the river and to succor them in case of distress. A similar society was afterward formed in France, where they built bridges and hospitals, maintained ferries, kept the roads in repair, and provided for the security of the highways. A bridge of 18 arches over the Rhône at Avignon, built by Saint Bénézet in 1177 and another of 22 arches over the same river at Pont Saint Esprit, built between 1265 and 1309, were among their greatest achievement in bridge-building. They gradually amassed great wealth by alms and gifts. In 1519 they were secularized on account of the abuses that had crept into the order.

Similar to these were the Knights and Companions of the Santa Hermandad in Spain; the Familiars and Cross-bearers in the service of the Spanish Inquisition; the Calendar Brothers in Germany; the Alexians in Germany, Poland and the Netherlands, etc. The professed object of the Alexians was to visit the sick and imprisoned; to collect alms for distribution; to console criminals, and accompany them to the place of execution; to bury the dead, and to cause masses to be said for those who had been executed, or for persons found dead. They derived their names from Alexius, their patron saint, and were at first principally composed of persons from the lower classes of the people in the Netherlands. They were afterward increased by the addition of the female branch, the Black Sisters. Although lay brothers they had houses, and formed their order into two provinces under an ecclesiastical government. They still exist, in the societies for burying dead bodies, in Antwerp, Utrecht and Cologne. The Brothers of Death, of the order of Saint Paul, were dressed in black, like the Alexians, and were distinguished by a death's head on their scapulary. They were suppressed by Pope Urban VIII.

There were also Gray Penitents (an old fraternity of an order existing as early as 1264 in Rome, and introduced into France under Henry III), the black fraternities of Mercy and of Death; the Red, the Blue, the Green and the Violet Penitents, so called from the color of their cowl; the divisions of each were known by the colors of the girdle or mantle. The fraternity of the Holy Trinity was founded at Rome in 1548 by Philip de' Neri for the relief of pilgrims and the cured dismissed from the hospitals. The Brothers of the Christian Schools are a fraternity founded near the end of the 17th century, the statutes of which were approved by Benedict XIII. Their labors have been of great service in the cause of elementary and secondary education in France, though their work is not confined to France but extends over a large part of the world, including Belgium, North and South America and England. They take religious vows, wear a suit of clerical dress and always work in pairs. In Ireland there is a body of Christian Brothers modeled on the French one, the first of its schools having been opened at Waterford in 1804. Their schools have spread over Ireland, and their system of education has received the approval of various royal commissions.

The Brothers of Common Life, founded at Deventer in Holland by the celebrated theologian, Gerald Groot, toward the end of the 14th century, and formally approved by Gregory XI in 1376, were a fraternity which performed great services to learning, especially theological learning. From Holland they spread rapidly over Germany, and increased so greatly in numbers that 500 houses belonged to the order in 1460. The Roman Catholic Church is indebted to it for a text of the Latin version of the Bible by Saint Jerome, most carefully prepared by a collation of the most ancient manuscripts. This text was consulted as an authority by the editors of the Bible prepared at the command of Sixtus V. The same order prepared some texts of the Christian fathers.

The Brothers of Charity are another fraternity whose hospitals are found in the principal cities. It was founded by Saint John de Dieu in Spain in 1540. Much better known in Great Britain are the Sisters of Charity (called also Gray Sisters, Daughters of Charity, Sisters of Saint Vincent de Paul), a Roman Catholic order founded in 1634 at Paris by Saint Vincent de Paul for the purpose of nursing the sick in hospitals. The sisters take vows of poverty, chastity and obedience, besides a vow binding themselves to serve the sick. Besides conducting hospitals and nursing, they sometimes undertake the management of poor schools. They attend the sick of every nation and religion. There is also a body of Irish Sisters of Charity, separate from the one just mentioned. See GREEK-LETTER SOCIETIES or COLLEGE FRATERNITIES and ORDERS, RELIGIOUS.

FRATERNITIES, College. See GREEK-LETTER SOCIETIES.

FRATICELLI, frăt-ĭ-sĕl-ĭ or chĕl'ē, a name applied to several heretic sects in the Middle Ages, more especially to those members of the order of Saint Francis who, in an endeavor to live up to the strict rule of their founder, created a split between the Spirituals and the Conventuals of the Franciscans (q.v.). They were generally opposed to existing ecclesiastical and social order and were similar to the Brethren of the Free Spirit, Beghards and other sects. They had no fixed place of residence. In the 14th and 15th centuries the Fraticelli made considerable progress and attracted more or less attention in northern Italy, from where they spread to a certain extent to southern France, Flanders and South Germany. They declared the existing Church as in a state of apostasy and looked upon poverty as an absolutely essential condition. Some of the popes persecuted them with great severity as heretics and many of them suffered greatly from the Inquisition. Consult Döllinger, J. J. I. von, 'Beiträge zur Sektengeschichte' (Munich 1890); Ehrle, F., in *Archiv für Litteratur und Kirchengeschichte des Mittelalters* (Vols. I–IV, Berlin 1885–88); Lea, H. C., 'History of the Inquisition of the Middle Ages' (3 vols., New York 1888).

FRATICELLANS. See FRATICELLI.

FRATRES ARVALES. See ARVAL BROTHERS.

FRATTAMAGGIORE, frä'ta-mä-jō'ra, Italy, city in the province of Naples, eight miles north of the city of Naples. It contains a fine church and has manufactories of silk and ropes. There are also many country homes of wealthy Neapolitans. Pop. 13,720.

FRAUD, *in law,* all deceitful practices in defrauding or endeavoring to defraud another of his known right, by means of some artful device, contrary to the plain rules of common honesty. It is condemned by the common law, and punishable according to the offense. All frauds and deceits for which there is no remedy by the ordinary course of law are properly cognizable in equity. Where a fraud can be clearly established, courts of law exercise a concurrent jurisdiction with courts of equity. Wherever fraud or surprise can be imputed to, or collected from, the circumstances, equity will interpose and grant relief against it. Where a person is party to a fraud, all that followed by reason of that fraud shall be said to be done by him. A party prejudiced by a fraud may file a bill in equity for a discovery of all its circumstances. Mere inadequacy of price alone is not a ground for a court to annul an agreement; but if there be such inadequacy as to show that the person did not understand the bargain he made, or was so oppressed that he was glad to make it, knowing its inadequacy, it will show a command over him which may amount to a fraud. If a person be fraudulently prevented from doing an act, equity will consider the act as done; and equity also relieves against bargains made under misconception of rights. In treaties, concealment of a material fact by one of the parties, in order to keep the other in ignorance, whereby to profit, is a gross fraud, and the contract will be set aside in equity. Constructive or legal fraud is applied to such acts or contracts as, though not originating in an actual evil design or contrivance to perpetrate a positive fraud or injury upon other persons, yet by their tendency to deceive or mislead other persons, or to violate public or private confidence, or to impair or injure the public interest, are deemed equally reprehensible with actual fraud, and are prohibited by law, as within the same reason and mischief as acts and contracts done *malo animo.* Gross criminal frauds are punishable by way of indictment or information. Frauds are not indictable at common law unless they be such as affect the public — as vending unwholesome provisions, or using false weights or measures; or by the way of conspiracy; or unless they affect the crown or the administration of justice. (See FRAUD, STATUTE OF; FRAUDULENT CONVEYANCES). Consult Bigelow, 'The Law of Fraud on its Civil Side' (Boston 1888); Browne, 'Construction of the Statute of Frauds' (1895); Kerr, 'Treatise on the Law of Fraud and Mistake' (4th ed., London 1910).

FRAUD, Prevention of, an exercise of police power to stop deception, or to render its commission more difficult, or to facilitate its detection. The principal field for legislation for the prevention of fraud is found in the business of brokers, agents and depositories — warehouse and commission men, auctioneers, etc.,— and in the sale of commodities, especially of substitutes, imitations and adulterations, bankrupt and fire sales, and sales by peddlers or other itinerant dealers. Fraud is legally dealt with either criminally,— generally in cases specified by statute,— or civilly by granting or withholding remedies, or by preventive measures.

Congress can legislate for the prevention of fraud so far as interstate and foreign commerce is concerned. The Pure Food Law of 1906 serves partly for that purpose. A city ordinance will usually cover protection against fraudulent practices, particularly in the retail sale of merchandise and in the services of hotel-keepers, cab and taxicab-drivers, for which a stranger is likely to call. A State may exercise its power for the prevention of fraud, even though interstate commerce is thereby indirectly affected; as example the sale of oleomargarine colored in imitation of butter was largely prohibited, though imported from other States and sought to be sold in original packages. As a useful article of commerce, however, the policy of prohibition of oleomargarine has been abandoned in all the States, the legislation against it showing evidences of a desire to use the power of fraud prevention so as to suppress competition.

Governmental regulations to prevent fraud include the requirement of licenses, of reports, of notices, labels and marks indicating the character and quality or quantity of merchandise; the fixing of standards of weights and measures and sometimes of the form of packages, and inspection by public officials.

FRAUD ORDERS, Postal, powers conferred on the Postmaster-General by act of Congress 19 Sept. 1890, to prohibit the use of the mails by persons believed to be conducting a fraudulent business. The necessity for the act was demonstrated by the fact that as the work of investigation proceeded, schemes for swindling through the mails were disclosed much more numerous and extensive than had been supposed. Many of the fraudulent enterprises proved to be as far-reaching in their ramifications as the postal service itself. Not only were thousands of credulous people swindled out of money foolishly invested, but confidence in legitimate enterprises was undermined. It was estimated that in 80 important cases early brought under the operation of the act, the American public in less than a decade had been swindled to the extent of a hundred million dollars. The arrest, conviction and imprisonment of the swindlers has proved effective in abating the fraudulent abuse of the mails. The constitutional question raised as to the authority of Congress to delegate power to the Postmaster-General to act in specific cases was definitely affirmed by the Supreme Court of the United States. The action of the Postmaster-General was thus made conclusive, no provision being made for a judicial review.

FRAUDS, Electoral. See ELECTORAL FRAUDS AND SAFEGUARDS AGAINST; CORRUPT PRACTICES ACTS; ELECTORAL COMMISSION; UNITED STATES — DISPUTED PRESIDENTIAL ELECTIONS.

FRAUDS, Statute of. Perhaps one of the most important statutes ever enacted in England or the United States was the Statute of Frauds (29 Charles II, chap. 3). It was passed in the year 1673. Its object is stated to be the "prevention of frauds and perjuries," and its effect is to make writing essential to the validity of many contracts or transactions. The most important sections are those relating to contracts; namely, the 4th and the 17th, almost every word of which has been the subject of numerous decisions. It is provided by the 4th section that no action shall be brought on the contracts therein mentioned unless the agreement or some note or memorandum thereof shall be in writing and signed by the party to be charged therewith, or some other person thereunto by him lawfully authorized. The contracts referred to are the following: (1) Any special promise by an executor or administrator to answer damages out of his own estate; (2) any special promise to answer for the debt, default or miscarriage of another person; (3) any agreement made upon consideration of marriage; (4) any contract or sale of lands, tenements and hereditaments, or any interest in or concerning them; and (5) any agreement that is not to be performed within the space of one year from the making thereof. This section, however, does not make the contract null and void, but only unactionable. The 17th section has reference to sales of goods for the price (or value) of £10, and upward, which are "not allowed to be good" unless some memorandum of the bargain has been made in writing, or unless the buyer shall accept part of the goods so sold, and actually receive the same, or give something in earnest to bind the bargain, or in part payment. In the statutes of the American States the principal alteration made in these terms is by the specification of a different sum of money. The sum usually established is $50, but in some of the States it is $30 or $40. Generally the statute has been construed not to render compliance with its provisions essential to the validity of the enumerated contracts, but only necessary to the proof of such contracts against the party who sets up the statute as a defense. The importance of this statute has been so fully recognized in this country that it has been substantially re-enacted in every State in the Union, and in some of them its provisions have been made still more comprehensive and stringent. The 17th section, however, has been discarded in 16 of the States: Alabama, Arizona, Delaware, Illinois, Kansas, Kentucky, Louisiana, New Mexico, North Carolina, Ohio, Pennsylvania, Rhode Island, Tennessee, Texas, Virginia and West Virginia. Consult 'Cyclopedia of the Laws of England,' (Vol. V); Browne, 'Treatise on the Construction of the Statute of Frauds' (5th ed., Boston 1895); Smith, 'Treatise on the Law of Frauds and the Statute of Frauds' (Indianapolis 1907). See CONTRACT; FRAUD; LEASE.

FRAUDULENT CONVEYANCES, in law, a fraudulent conveyance is a conveyance the object, tendency or effect of which is to defraud another not a party to such a conveyance, or the intent of which is to avoid some debt or duty due by or incumbent on the party making it. Conveyances of this character are declared invalid by two celebrated English statutes which have been substantially re-enacted throughout the United States with the same provisions. The first of these statutes was passed in the 13th year of the reign of Queen Elizabeth (1571), and commonly referred to as the statute 13 Eliz. chap. 5, and by it all fraudulent conveyances, gifts or alienations of lands or goods whereby creditors might be in anywise disturbed, hindered, delayed or defrauded of their just rights are rendered utterly void; but the statute does not extend to any estate or interest in lands on good consideration, and bona-fide conveyed to any person not having notice of such fraud. The second statute against fraudulent conveyances is the statute 27 Eliz. chap. 4, which was passed in 1585. It provides that the conveyance of any interest in lands for the intent and purpose to defraud and deceive subsequent bona-fide purchasers of the lands for a good and sufficient consideration shall be utterly void. This statute differs from the one first mentioned in applying solely to lands, and in protecting the interests of purchasers instead of creditors; but it contains similar provisions declaring the validity of any previous conveyance if it be upon valuable consideration and to a bona-fide purchaser. It has been held in England, in the interpretation of this statute, that if the previous conveyance be voluntary it is void as to a subsequent purchaser, even if he had notice before he received his deed that such a conveyance had been made. This doctrine has been generally rejected by the courts throughout the United States as unjust, and the principle adopted that the receipt of notice gives a person intending to purchase sufficient opportunity to protect his own interests, and if he is guilty of imprudence in accepting the conveyance he should receive no assistance from the courts. This appears to be the more unobjectionable doctrine. Voluntary conveyances are never set aside under either statute, as between the immediate parties, but only in favor of purchasers or creditors. Consult Bigelow, 'The Law of Fraudulent Conveyances' (Boston 1911); Hunt, 'The Law Relating to Fraudulent Conveyances' (London 1897); Moore, 'Treatise on Fraudulent Conveyances' (2 vols., Albany 1908). See FRAUD.

FRAUENBURG, frow'en-boorH, Germany, town in the district of Königsberg, Prussia, on the Frische Hoff, 41 miles southwest of Königsberg. The chief products are garden truck, flour and cereals. A forest school is situated here. Copernicus was canon of the cathedral and died here in 1543. His tomb is in the Gothic cathedral erected in 1329. Pop. 2,522.

FRAUENFELD, frow'en-felt. Switzerland, capital of the canton of Thurgau, 25 miles northeast of Zürich, on the Murg. It is situated in a beautiful and fertile district, and is of importance as the centre of trade for the fruit, wine and agricultural products of the district. It is a well-built town and contains a church which was built in 1286 and an ancient castle, the government building, which contains the archives of the canton and a library, the town hall and military barracks. It is the seat of a technical school with historical and scientific collections, and has manufactories of gloves, cotton and iron goods, machinery, leather and guns. Pop. 8,105.

FRAUENLOB, frow'en-lōb, the assumed name of Heinrich von Meissen, German minnesinger: b. 1250; d. 1318. For several years he wandered as a minstrel and then established the first school of the meistersingers at Mainz. The ladies of Mainz are said to have carried his bier to the cathedral in appreciation of his life-long chivalrous devotion to their sex. His tomb was restored in 1783 by ladies during the Werther period of German literature, and the ladies of Mainz erected a beautiful monument to his memory near his tomb in 1842. Ettmüller published an edition of his poems in 1843. They are bombastic and artificial in style. One of his works, the 'Cantica Canticorum,' has appeared in English.

FRAUNCES' TAVERN, an ancient building at the southeast corner of Broad and Pearl streets, New York. It was originally built by the Delancey family and long occupied as a mansion. Afterward it was transformed into a tavern. After the British evacuation of New York it was for a time the headquarters of Gen. George Washington, who here on 4 Dec. 1783 delivered his farewell address to his officers. In 1768 the New York Chamber of Commerce was founded here, and in 1902 it was purchased and restored by the Sons of the Revolution, who have thus preserved for posterity one of the famous landmarks of Revolutionary days. The tavern is still maintained.

FRAUNHOFER, frown'hō-fĕr, **Joseph von,** German mathematician: b. Straubing, Bavaria, 6 March 1787; d. Munich, 7 June 1826. In 1799 he was placed with a looking-glass maker and glass-grinder at Munich. After various vicissitudes he received an appointment as optician in the mathematical and mechanical institute of Reichenbach and Utzschneider at Benedictbeuren, and in 1809 the mechanical part of the optical institute was chiefly under his direction. In the same year he became one of the members of the firm under which the business was conducted, and in 1818 its director. In 1823, after it was moved to Munich, Fraunhofer became a member of the Academy of Science, its conservator of physics and was made a member of the nobility in 1824. One of the most difficult operations of practical optics was to polish the spherical surfaces of large object-glasses accurately. Fraunhofer invented a machine which obviated this difficulty, and rendered the surface more accurate than it was left by the grinding. He invented also other grinding and polishing machines, and introduced many improvements into the manufacture of the different kinds of glass used for optical instruments, and which he found to be always injured by flaws and irregularities of various sorts. In 1811 he constructed a new kind of furnace, and on the second occasion when he melted a large quantity found that he could produce flint-glass, which, taken from the bottom of a vessel containing two hundredweight of glass, had the same refractive power as glass taken from the surface. He found that the English crown-glass and the German table-glass both contained defects occasioning irregular refraction. In the thicker and larger glasses there would be more of such defects, so that in larger telescopes this kind of glass would not be fit for object-glasses. Fraunhofer therefore made his own crown-glass. The cause which had hitherto prevented the accurate determination of the power of a given medium to refract the rays of light and separate the different colors which they contain was chiefly the circumstance that the colors of the spectrum have no precise limits, and that the transition from one to another is gradual and not immediate; hence, the angle of refraction cannot in the case of large spectra be measured within 10 feet or 15 feet. To obviate this, Fraunhofer made a series of experiments for the purpose of producing homogeneous light artificially, and unable to effect his object in a direct way, he did so by means of lamps and prisms. In the course of these experiments he discovered that bright fixed line which appears in the orange color of the spectrum when it is produced by the light of fire. This line enabled him afterward to determine the absolute power of refraction in different substances. Experiments to ascertain whether the solar spectrum contains the same bright line in the orange as that produced by the light of fire led him to the discovery of the innumerable dark fixed lines in the solar spectrum, consisting of perfectly homogeneous colors and now bearing his name. The importance of this discovery can scarcely be overestimated. It led to the invention and use of the spectroscope (q.v.), to the science of spectroscopy (q.v.), and to all our present knowledge of solar and stellar chemistry. Fraunhofer also made a variety of other important discoveries and inventions. He made the great refracting telescope for Dorpat. His writings were edited by Lommel as 'Gesammelte Schriften' (Munich 1888). Some of his writings were translated into English by J. S. Ames and published as the second volume of 'Harper's Scientific Memoirs' under the title 'Prismatic and Diffraction Spectra' (New York 1898). Consult Anon., 'Life of Fraunhofer' (in *American Journal of Science and Art,* Vol. XVI, p. 304, New Haven 1829); Voit, 'Joseph Fraunhofer' (Munich 1887).

FRAUNHOFER LINES. See SPECTROSCOPY.

FRAU SORGE, frow'sôr'ge (DAME CARE). 'Frau Sorge,' the first of Herman Sudermann's complete novels (1887) and the work which brought him his fame as a writer of fiction, as 'Die Ehre,' his first play, placed him in the front rank among contemporary dramatists, stands out in the long list of his novels and plays in two ways; as an art-work it is the most perfect, and it is the one which shows least the wear and tear of a generation of social change. Those may be merely two ways of saying the same thing; namely, that in a writer who combines, as Sudermann does, the qualities of a poet and a realist, the more highly imaginative works have a more permanent value than the controversial ones. Into this grim tale of East Prussian peasant life, with its hint of autobiography in the spirit and the scene, if not in the story, Sudermann has infused something of the spirit of the epic, the narrative of the toiler battling against the forces of nature. The legend of Frau Sorge (Dame Care) with which the story ends and around which it is conceived is a fine bit of imaginative writing. It is the story of a mother so poor and lonely that she had no one to act as godmother for her son except Dame Care, who offers to see that the boy grows up to be a good man who shall never go hungry if his mother will give the boy's soul, with his youth and his hope of happiness, as a hostage to Dame Care. The rending of the charm by the power of a woman's love and the solemn, but never tragic, quality of the story, are distinguishing characteristics of Sudermann's work.

EDITH J. ISAACS.

FRAXINELLA. See DITTANY.

FRAY BENTOS. See INDEPENDENCIA.

FRAY GERUNDIO. See LA FUENTE, MODESTO.

FRAYSSINOUS, frā'sē-noos', **Denis Antoine Luc, Count de,** French prelate and statesman: b. Curières, Aveyron, 1765; d. 1841. He entered the ministry and attained fame by his conferences at l'Eglise de Saint Sulpice in 1803–09. In the latter year they were prohibited by Napoleon. In 1816 he was made court preacher and almoner of Louis XVIII, and became Minister of Public Worship in 1824–28. He was made a peer of France and the Jesuits were readmitted to France during his term as minister. In 1822 he was elected to the Academy. The Revolution compelled him to leave France and he sojourned for a time at Rome and at Prague. His 'Défense du christianisme' (3 vols., 1825) had a great vogue in his day and went through several editions. Consult his life by Henrion (2 vols., Paris 1844).

FRAZER, SIR **James George,** English anthropologist: b. Glasgow, Scotland, 1854. He became a Fellow of Trinity College, Cambridge, and was appointed professor of social anthropology at the University of Liverpool in 1907. His works are of the greatest importance in the study of anthropology, and particularly of religion and myth. He is a Fellow of the British Academy, honorary Fellow of the Royal Society of Edinburgh and corresponding member of the Royal Prussian Academy of Science. He has published a revised edition of 'Long's Sallust' (1884); 'Totemism' (1887); 'The Golden Bough' (1890; 2d ed., 1900); 'Passages of the Bible chosen for their Literary Beauty and Interest' (1895; 2d ed., 1909); 'Pausanias's Description of Greece,' translated with a commentary (1898; 2d ed., 1913); 'Pausanias and Other Greek Sketches' (1900); 'Lectures on the Early History of the Kingship' (1905); 'Adonis, Attis, Osiris, Studies in the History of Oriental Religion' (1906; 2d ed., 1907; 3d ed., 1914); 'Questions on the Customs, Beliefs, and Languages of Savages' (1907); 'The Scope of Social Anthropology' (1908); 'Psyche's Task, a Discourse concerning the Influence of Superstition on the Growth of Institutions' (1909; 2d ed. 1913); 'Totemism and Exogamy' (1910); 'The Magic Art and the Evolution of Kings' (1911); 'Taboo and the Perils of the Soul' (1911); 'The Dying God' (1911); 'Letters of William Cowper,' chosen and edited with a memoir and a few notes (1912); 'Spirits of the Corn and of the Wild' (1912); 'The Belief in Immortality and the Worship of the Dead' (Vol. I, 1913); 'The Scapegoat' (1913); 'Balder the Beautiful' (1913); 'Essays of Joseph Addison,' chosen and edited with a preface and a few notes (1915); 'The Golden Bough' (Vol. XII, Bibliography and Index, 1915).

FRAZER, John Fries, American scientist: b. Philadelphia, 8 July 1812; d. there, 12 Oct. 1872. He was a grandson of Lieut-Col. Persifor Frazer of the Revolution. Graduated with highest honors at the University of Pennsylvania in 1829, he afterward completed a course in law, was admitted to the bar, but soon gave up the practice of this profession in favor of the natural sciences. With Prof. A. D. Bache he made the first researches on magnetics in the United States. In 1836 he became one of the two assistants on the First Geological Survey of Pennsylvania. After filling for some time a professorship in the Philadelphia High School, in 1844 he succeeded Professor Bache as professor of natural philosophy and chemistry in the University of Pennsylvania, serving until his death; and from 1855–68 also as vice-provost. In 1857 he received the degree of LL.D. from Harvard. He was an active member of the American Philosophical Society (its vice-president in 1855), the Academy of Natural Sciences, and the Franklin Institute (the editor of its journal from 1850 to 1866), and one of the charter members of the National Academy of Sciences. Consult Le Conte, T. L., 'Memoir of J. F. Frazer' (in National Academy of Sciences, *Biographical Memoirs,* Vol. I, p. 245, Washington 1877).

FRAZER, Persifor, American geologist, son of preceding: b. Philadelphia, 24 July 1844; d. 1909. After graduation (1862) from the University of Pennsylvania, served during Civil War in the Mississippi squadron (1863–65); was mineralogist and metallurgist to the United States Geological Survey (1869–70), professor of chemistry in the University of Pennsylvania (1870–74), assistant geologist Second Geological Survey of Pennsylvania (1874–82). He was the first foreigner to receive the degree of Docteur-ès-Sciences Naturelles from France, which also gave him the decoration of the golden palms of the Academy. He served as vice-president, representing the United States in the International Geological Congress of 1888 (London), and of 1897 (Saint Petersburg). The John Scott medal was awarded to him in 1905. He wrote extensively for scientific periodicals, published five volumes of Reports of the Geological Survey of Pennsylvania; 'Tables for the Determination of Minerals' (1874); and 'Bibliotics or the Study of Documents' (1894).

FRAZIERS FARM, Battle of. See GLENDALE, BATTLE OF.

FREAR Walter Francis, American jurist: b. Grass Valley, Cal., 29 Oct. 1863. He was graduated at Yale University in 1885, and at the Yale Law School in 1890; and received the degree of LL.D. from Yale University in 1910;

was made second judge of the First Circuit Court of Hawaii, in January 1893, associate justice of the Supreme Court of Hawaii in March 1893. He was a member of the commission to recommend to Congress legislation for Hawaii, in August 1898; was appointed chairman of the Hawaiian Code Commission in 1903; became chief justice of the Supreme Court of Hawaii in July 1900 and governor 1907–13. He was chairman of the Hawaiian delegation to the National Republican Convention in 1912. He is the author of 'Evolution of the Hawaiian Judiciary,' etc.

FREAR, William, American agricultural chemist: b. Reading, Pa., 24 March 1860. He was graduated at Lewisburg (now Bucknell) University in 1881, and was assistant in sciences there in 1881–83, when he became assistant chemist of the United States Department of Agriculture. In 1885–1907 he was professor of agricultural chemistry, and after 1907 of experimental agricultural chemistry at the Pennsylvania State College of Agriculture. Meanwhile he held various important posts in State agricultural work. Since 1900 he has been special agent of the United States Department of Agriculture and is also chief chemist of the Pennsylvania Dairy and Food Bureau. He edited *Agricultural Science* in 1892–94 and is a member of many scientific societies. His writing is confined exclusively to communications to scientific periodicals and experiment station and State reports.

FRECHETTE, frā-shĕt, **Louis Honoré,** French-Canadian poet; b. Levis, Quebec, 16 Nov. 1839; d. 31 May 1908. He edited several French-Canadian journals and in 1889 became clerk of the legislative council of Quebec. His lyrics were much admired both for their form and sincerity of passion. He published 'Mes Loisirs' (1863); 'La Voix d'un Exilé' (1869); 'Pêle Mele' (1877); 'Les Fleurs Boreales,' crowned by the French Academy (1879); 'Les Oiseaux de Niège' (1879); 'La Legende d'un Peuple' (1887); 'Les Feuilles Volonte' (1891); 'Veronica,' a drama; and in prose 'Letters à Bastile' (1872); 'Histoire Critique des Rois de France' (1881); 'Originaux et Detraques' (1892); 'Letters sur l'Education' (1893); 'La Noël au Canada' (1900).

FRECKLES, brownish-yellow spots of a circular form on the human skin. They are due to excess of pigmentary matter in the cells of the cuticle, immediately above the true skin, and only appear on those exposed surfaces, as the neck, face, hands and arms. They are sometimes congregated in thick clusters which give to the features an unsightly appearance. Sometimes freckles are hereditary, appearing soon after birth and continuing through life, or subsiding or vanishing altogether. This affection is most common as well as most persistent in persons of fair complexion and hair, and especially so in those with red hair. There can be no doubt that exposure to the sun increases the disfigurement. One of the milder treatments for removing freckles is a solution of 15 to 30 grains of hyposulphite of soda, or of chloride of ammonium, 15 grains to one ounce of water. A beneficial remedy, to be used as a wash at night and in the morning, is a mixture of bichloride of mercury, dilute acetic acid, borax and rose water.

FREDEGAR, or **FREDEGARIUS SCHOLASTICUS,** chronicler of the Franks, who flourished in the 7th century and was one of the three compilers of the celebrated 'Historia Francorum,' a history of the Franks down to 642 A.D. It is invaluable as a source book for the history of France during the first half of the 7th century. It is written in corrupt Latin, and was continued in the 8th century in the work known as 'Gesta Francorum.' Fredegar traced the Franks in direct line from the Trojans. Consult Krusch, 'Fredegarii et Aliorum Chronica' (Hanover 1888).

FREDERIC, Harold, American novelist: b. Utica, N. Y., 19 Aug. 1856; d. Hornby, England, 19 Oct. 1898. After receiving an education in the schools of his native city, he entered the profession of journalism there, working later on papers in Albany and New York. In 1884 he was appointed London correspondent of the New York *Times*, retaining this position until his death. His best works were his novels, of which the two greatest are 'In the Valley' (1890), a historical novel of upper New York, and 'The Damnation of Theron Ware' (1896), a searching analysis of the life of the American bourgeoisie. Among his other novels are: 'Seth's Brother's Wife' (1887); 'The Lawton Girl' (1890); 'The Return of O'Mahoney' (1892); 'The New Exodus,' a story of Jewish life, written after his visit to Russia (1892); 'The Copperhead' (1894), a Civil War story, dramatized and produced with considerable success in 1917; 'Marsena' (1895), humorous tales; 'March Hares' (1896); 'Gloria Mundi' (1898); 'In the Market Place' (1899). See IN THE VALLEY.

FREDERICIA, frĕd-ĕ-rĭsh'ē-ā, Denmark, seaport, on the coast of Jutland. It was at one time well fortified, but the forts have not been kept in repair. The chief exports are eggs, meat, fish, cheese and butter; the chief imports are cotton and woolen goods, fruit, salt and petroleum. Pop. 14,228.

FREDERICK (Friedrich Maria Albrécht Wilhelm Karl), Archduke of Austria: b. Gross-Seelowitz, near Brünn, 1856. His training was almost exclusively military. In 1905 he was made general of infantry and army inspector, and in 1907 commander of the Landwehr. Upon the death of Prince Francis Ferdinand in 1914 he became practically chief commander of the Austro-Hungarian army. The Albertina collection of engravings and drawings is housed in his palace at Vienna.

FREDERICK I, First Elector of Brandenburg, of the house of Hohenzollern: b. 1371; d. 1440. In 1398 he succeeded his father, Frederick V, Burgrave of Nuremberg. He served in the army of Hungary, and at the battle of Nicopolis in 1396 effected the rescue of King Sigismund. He supported the candidacy of Sigismund for the imperial crown and in recognition of his services was made Elector of Brandenburg in 1417, after he had been administrator for seven years. He thus became the founder of the royal Prussian dynasty. He quarreled with Sigismund in 1423 and in 1427 sold his rights as Burgrave of Nuremberg to the city. He was a candidate for the throne of Germany in 1438. Consult Brandenburg, 'König Sigmund und Kurfürst Friedrich I' (Berlin 1891).

FREDERICK III, Elector of Brandenburg. See FREDERICK I OF PRUSSIA.

FREDERICK I, king of Denmark and Norway: b. 3 Sept. 1471; d. 10 April 1533. While joint ruler of Schleswig-Holstein, he succeeded his nephew Christiern (or Christian) II, on the deposition of the latter, in 1523, and entered into an alliance with Gustavus I, king of Sweden. After taking Copenhagen, he gained over all the nobility, to whom he granted privileges at the expense of the throne, and introduced Lutheranism into his dominions.

FREDERICK II, king of Denmark and Norway, the son and successor of Christian III: b. 1534; d. 1588. He ascended the throne in 1559. He subdued the Ditmarshers of West Holstein in 1559, suppressed piracy in the Baltic and North Sea, founded the fortress of Kronborg, and waged a successful war against Sweden (1563–70). He was a friend of learning, was served well by his counselors and was beloved by his people.

FREDERICK III, king of Denmark and Norway: b. Hadersleben, Schleswig, 18 March 1609; d. Copenhagen, 6 Feb. 1670. He succeeded his father Christian IV, in 1648. The most remarkable event of his reign was his changing of the constitution from an elective to an hereditary monarchy.

FREDERICK IV, king of Denmark: b. Copenhagen, 11 Oct. 1671; d. there, 12 Oct. 1730. He ascended the throne on the death of Christian V in 1699. He leagued against Charles XII of Sweden, who forced him to make peace; but when Charles fled to Turkey, Frederick drove the Swedes out of Norway, and concluded a favorable peace, retaining possession of the duchy of Schleswig.

FREDERICK V, king of Denmark and Norway: b. Copenhagen, 31 March 1723; d. 14 Jan. 1766. He came to the throne in 1746. The character of his reign may be inferred from the following remark, which, on his deathbed, he made to his successor, Christian VII: «It is a great consolation to me, my son, that I have not injured any person and that my hands are not stained with one drop of blood.»

FREDERICK VI, king of Denmark and Norway: b. Copenhagen, 28 Jan. 1768; d. there, 3 Dec. 1839. He became regent in 1784, following on the mental eclipse of his father. Having joined the Armed Neutrality of the North against England in 1800, all Danish ships in English harbors were seized and the Danish fleet destroyed at Copenhagen (21 April 1801). The regent thereupon withdrew from the alliance. Having again allied himself with Napoleon, Copenhagen was bombarded by the British (25 Sept. 1807). On his accession in 1808, he had waged a war with the Swedes, who attempted to possess themselves of Norway. He succeeded in defeating them and peace was signed in 1809. Norway was taken by the Allies in 1814 and handed over to Sweden; Pomerania and the isle of Rügen falling to Denmark. His country emerged from the Napoleonic wars in a bankrupt and prostrate condition; but under the able guidance of the chief minister, Bernstorff, great progressive measures were carried through, among them peasant emancipation, freedom of the press, prison reform and Jewish emancipation; savings banks were established, education encouraged and a representative system of government set up.

FREDERICK VII, king of Denmark: b. Copenhagen, 6 Oct. 1808; d. Glücksburg, 15 Nov. 1863. He ascended the throne in 1848. The principal events of his reign were the revolution in Schleswig and Holstein, and the dispute over the succession to Denmark and the duchies, the king himself and his uncle, the heir-presumptive, being childless.

FREDERICK VIII, king of Denmark: b. 1843; d. Hamburg, 14 May 1912. He was the eldest son of Christian IX and of Queen Louisa of Hesse-Cassel. He received his education at a grammar school and fought against Germany in 1864. He also studied at Oxford and traveled abroad. In 1869 he married Princess Louisa of Sweden, niece of Oscar II. He succeeded his father on 29 Jan. 1906. In 1905 his second son, Charles, became king of Norway, under the title of Haakon VII. He was a brother of Queen Alexandra of England and of King George I of Greece. He died suddenly at Hamburg, and for several hours his body was not identified.

FREDERICK III («The Fair»), German king and Duke of Austria: b. 1286; d. Gutenstein, 13 Jan. 1330. On the death of his father, Albert I, he failed to gain the throne, which went to Henry VII. On the death of the latter a few of the electors favored Frederick, chose him as king, and he was crowned by the Archbishop of Cologne in 1314. The majority of the electors, however, chose his cousin, Louis IV, Duke of Upper Bavaria, and war was carried on until the capture of Frederick at Mühldorf in 1322. Frederick was imprisoned for three years, when he was released for a short time, returning to captivity in accordance with an agreement between him and Louis, and remaining in captivity until his death.

FREDERICK I, surnamed BARBAROSSA or RED BEARD, emperor of the Holy Roman Empire, son of Frederick, Duke of Suabia: b. 1123; d. June 1190. He was chosen to succeed his uncle, Conrad III, in 1152. He was crowned at Aix-la-Chapelle a few days after his election. His great ambition was to secure the independence of the empire and, above all, to be master of Italy. His first expedition to Italy was made in 1154, when, after subduing several towns in Lombardy, he went to Rome, and after some delays, had himself crowned emperor by Adrian IV (18 June 1155). He marched again into Italy in 1158, took Brescia and Milan, and at the celebrated Diet at Roncaglia assumed the sovereignty of the towns and received the homage of the lords. On his return to Germany he triumphed over Bohemia, and made Poland tributary to the empire. After the death of Pope Adrian, Frederick had three anti-popes in succession elected in opposition to Alexander III, who excommunicated him and his pope, Victor. The same year, 1160, he besieged and took Crema, after a most courageous defense. In 1162 he conquered Milan, and had many of the public buildings destroyed, as well as parts of the fortifications; after which the other towns of Lombardy submitted to him. In 1166, he traversed the Romagna, levied contributions on the towns, besieged Ancona and had himself crowned a second time at Rome by the anti-pope, Pascal, but pestilence broke out in his army and he was forced to return to Germany. In 1174 he besieged unsuccessfully the newly founded town of Alessandria, and in 1176 was totally defeated by the Milanese at Como. This reverse was not lost on him, for it changed his policy of repression. In 1183 he made peace with the Pope and the towns of Lombardy. In 1188 he assumed the cross, set out in the following year on the third crusade, was opposed on the march by the Greek emperor and the sultan, arrived in Asia, and was drowned while crossing a river.

Frederick was great, not only as a soldier, but as a ruler. His administration was marked by justice, his subordinate officers were chosen for their capacity and probity, he was himself an educated man and promoted education and literature. His politic measures held in check the power of the nobles of Germany by the granting of municipal privileges to the cities. His memory is still cherished among the peasants of Germany, who dream of the return of Fritz Redbeard, as the Welsh did of King Arthur. Consult Prutz, 'Kaiser Friedrich I' (1871–73); Fischer, 'Kreuzzug Friedrich I' (1870).

FREDERICK II, emperor of the Holy Roman Empire: b. Jesi, near Ancona, Italy, 26 Dec. 1194; d. Fiorentino, 13 Dec. 1250. He was elected king of the Romans in 1196, again after the death of his father, Henry VI, and a third time on the excommunication of Otho IV, in 1211. He was already king of Sicily and duke of Suabia, under the joint regency of his mother and Pope Innocent II. He made a league with Philip Augustus, king of France, and after the defeat of Otho by the latter at the battle of Bouvines, was crowned at Aix-la-Chapelle in 1215. He received the imperial crown at Rome in 1220, on which occasion he had to renew a vow previously extorted from him to take the cross. In 1225 he married as his second wife, Yolande, daughter of John of Brienne, king of Jerusalem, and in 1227 embarked for the Holy Land. Illness compelled him in a few days to abandon the enterprise, and for this he was excommunicated by Pope Gregory IX. He set out again in 1228, and the Pope exciting opposition to him and invading his hereditary states, he at once concluded a truce with Kameel, the sultan of Egypt, by which he became master of Jerusalem. He entered the city, crowned himself (no priest daring to do it), and returned to Europe. He recovered his states, made peace with the Pope and suppressed the revolt of his son Henry, who was then imprisoned for life. In 1235 Frederick began the war with the cities of Lombardy, having for his ally Eccelino, tyrant of Verona. After his victory of Cortenuova, he took Ravenna, Faenza and Benevento; and in 1241 his fleet defeated that of the Genoese, and captured the cardinals and bishops who were on their way to attend a council against him. Frederick promoted the election of Innocent IV, who had been his friend and made a treaty with him, but soon found Innocent a most determined enemy. A new anathema and sentence of deposition and release of his subjects from their allegiance to him was published in 1245. The mediation of Saint Louis utterly failed to bend the Pope to reconciliation. Rival emperors were set up, the war in Italy continued, Parma was lost in 1248, his, Frederick's, son, Enzio, was defeated and made prisoner in the following year. Frederick was the most accomplished sovereign of the Middle Ages; but his strong sympathies with his Italian motherland and his unremitting endeavors to establish a compact and all-supreme empire in Italy, were the causes not only of his own misfortune but of the miseries which he brought on the German empire by embroiling it in costly wars abroad and leading him to neglect the welfare and to sacrifice the interests of his German subjects.

FREDERICK III («The Pacific»), emperor of the Holy Roman Empire: b. Innsbruck, 21 Sept. 1415; d. Linz, 19 Aug. 1493. He was elected emperor in 1440, and reigned for 53 years, the longest German reign. He was of a slow, phlegmatic temper and in his hands the imperial authority declined. The Concordat of Vienna in 1448 put an end to the nationalization of the Church in Germany which had been attained at the Council of Constance. Frederick failed in his claim to the crown of Hungary, but in his reign the Hungarians were expelled from Vienna. He showed foresight in his alliances: the Swabian League, formed in 1487 to maintain the authority of the empire, led to the peaceful annexation of the Tyrol. He effected a stroke of diplomancy by the marriage of his son, Maximilian, to Mary, daughter and heir of Charles the Bold of Burgundy, to whom he surrendered the kingdom of the Romans in 1486.

FREDERICK I («the Victorious»), elector-palatine: b. 1425; d. 1476. In 1439 he received a portion of the Palatinate on the death of his father. This he ceded some time later to his brother, Louis. After the latter's death he became guardian of his infant nephew, Philip, and administered the government. He was made elector for life in 1451 owing to the external troubles which threatened the Palatinate, but renounced the succession of his children in favor of his nephew. He opposed Frederick III, and had to defend himself against the defection of his allies. In 1462 he won the brilliant victory of Seckenheim, and thereby increased the territory of the Palatinate and secured undisturbed possession of the electorship for his lifetime. Consult Feeser, 'Friedrich der Siegreiche' (Neuburg 1880), and the biography by Menzel (Munich 1861).

FREDERICK II («the Wise»), elector-palatine: b. 1482; d. 1556. He ascended the throne in 1544, succeeding his brother, Louis. He was in command of the imperial army in 1529 when the Sultan Solyman appeared before Vienna. He came under the influence of Melanchthon, and joined the Schmalkald League. Consult Rott, 'Friedrich II von der Pfalz und die Reformation' (Heidelberg 1904).

FREDERICK III («the Pious»), elector-palatine: b. 1515; d. 1576. He became elector-palatine in 1559 upon the extinction of the elder Palatine line. He had become a Lutheran in 1546, and by his embracing the Calvinistic faith in 1561 alienated the Lutheran princes. He aided the French reformers and also those of the Netherlands. His supervision of the drawing up of the Heidelberg catechism in 1563 placed Calvinism on a systematic foundation. Consult Kluckhohn, A., 'Friedrich der Fromme' (Nordlingen 1877–79).

FREDERICK IV ("the Upright"), elector-palatine: b. 1574; d. 1710. Son of elector Louis VI. His father died during his infancy, and his uncle, John Casimir, was his guardian until he assumed the crown in 1592. The Protestant Union was formed in 1608, chiefly through his influence, and his whole reign is noted for his firm adherence to the Protestant cause. Consult Haüsser, L., 'Geschichte der rheinischen Pfalz' (Heidelberg 1856).

FREDERICK V, elector-palatine and king of Bohemia: b. Amberg, 1596; d. Mainz, Germany, 29 Nov. 1632. He succeeded his father, Frederick IV, in 1610. In 1613 he married the Princess Elizabeth, daughter of James I, of England. In 1619, on the death of the Emperor Matthias, he accepted the crown of Bohemia in opposition to the Hapsburg claimant. He made a triumphal entry into Prague, which was followed in 1620 by his total defeat by the Imperial forces at the battle of Prague, and the loss of his kingdom and hereditary states. He then took refuge in Holland. He was succeeded by his cousin, Maximilian of Bavaria, the head of the Catholic League. Two of his sons, Prince Rupert and Prince Maurice, were celebrated in the Civil Wars in England. His daughter, Sophia, who was married to Ernest Augustus, afterward Elector of Hanover, became the mother of George I of England.

FREDERICK I, first king of Prussia (FREDERICK III, as elector of Brandenburg): b. Königsberg, 11 July 1657; d. Berlin, 25 Feb. 1713. He succeeded his father in 1688, entered into the alliance against France, supported William of Orange in his English expedition, and seized Bonn and other towns, sent auxiliaries to the emperor against the Turks, and, after a dispute of some years, sold to the emperor the circle Schwiebus, which the Great Elector had acquired in exchange for the principalities of Liegnitz, Brieg and Wohlau. He supported the emperor in the war of the Spanish Succession, and in 1701 obtained from him the title of king, which he had long coveted. Frederick gratified his love of pomp in the ceremony of his coronation at Königsberg, the cost of which exhausted his treasury for a time. He placed the crown on his head with his own hands. In 1694 he founded the University of Halle; two years later the Berlin Academy of Painting; and, in 1707, he established the Academy of Sciences, Berlin, and made Leibnitz first president.

FREDERICK II, best known as **FREDERICK THE GREAT**, king of Prussia: b. 24 Jan. 1712; d. Sans Souci, 17 Aug. 1786. He was the son of Frederick William I and the Princess Sophia Dorothea of Hanover. Though by the direction of his father, he was instructed only in the details of military exercises and service, his taste for poetry and music was early developed by the influence of his first instructress, Madame de Rocoules, and his early teacher, Duhan, who, countenanced by the queen, formed a secret opposition to his father's system of education. The prince's inclination led him to adopt entirely the views of his mother. This gave rise to a coolness between him and his father. Indignant at the oppression and hatred which he experienced from his father, Frederick determined to flee to the court of George II, king of England, his mother's brother. His sister Frederica and his friends, Lieutenants Katt and Keith, were the only persons entrusted with the secret of his flight. He was, however, overtaken, was barbarously treated by his father, and obliged to be an eye-witness of the execution of his friend Katt.

While the prince remained in the closest confinement in Küstrin, the king sent him a proposal to renounce the succession in favor of his younger brother Augustus William, on condition that he should have the liberty of pursuing his own inclinations in regard to his studies, traveling, etc. "I accept the proposal," said the prince, "if my father declares that I am not really his son." On this answer the king, who looked on conjugal fidelity with religious respect, relinquished his design. That the king was inclined to sentence his son to death is certain. But the provosts Reinbeck and Seckendorf, who had before intrigued against the prince, now saved his life; the latter, in particular, by availing himself of the interference of the emperor.

The prince was not admitted to court till on the occasion of the nuptials of his sister Frederica, and was obliged by his father in 1733 to marry the Princess Elizabeth Christina, daughter of Ferdinand Albert, Duke of Brunswick-Bevern. Frederick William gave the castle of Schönhausen to her, and to the prince the county of Ruppin, and in 1734 the town of Rheinsberg, where he lived devoted to study till he ascended the throne. Among his daily visitors were literati, musicians and painters. He corresponded with foreign scholars, particularly with Voltaire, whom he greatly admired. Several of his writings, in particular his 'Anti-Machiavel,' had their origin in the rural tranquillity of Rheinsberg.

The death of his father raised him to the throne 31 May 1740. Frederick on his succession found in his states a population of only 2,240,000. At his decease the number had risen to 6,000,000. He raised Prussia to a pitch of greatness by his talents as a legislator and general, assisted in the field and in the cabinet during a reign of 46 years by many distinguished men. Frederick, who had already excited great expectations, retained for the most part the institutions and laws of his father, but gave to the latter more extent and vigor. The death of the Emperor Charles VI was a favorable moment, of which Frederick II took advantage, to revive the claims of the house of Brandenburg with regard to the Silesian principalities, so far as to ask from the queen, Maria Theresa, the duchies of Glogau and Sagan, in return for which he promised her assistance against all her enemies, his vote for the election of her husband as emperor, and 2,000,000 Prussian dollars. These proposals being rejected, he occupied Lower Silesia in December 1740, and defeated the Austrians 10 April 1741, near Molwitz. This victory, which was almost decisive of the fate of Silesia, raised new enemies against Austria. France and Bavaria united with Prussia, and the war of the Austrian Succession commenced. The only ally of the queen of Hungary and Bohemia, George II of England, advised her to make peace with Prussia because Frederick II was her most active and formidable enemy. After the victory of Czaslau (Chotusitz), gained by Frederick, 17 May 1742, the first Silesian War was terminated by preliminaries signed at Breslau under British mediation (11 June), and by the peace signed at Berlin, 28 July 1742. Frederick obtained Lower and Upper Silesia, and the larger part of the county of Glatz, with full sovereignty. On the other hand he renounced all claims to the other Austrian territories, assumed a debt of 1,700,000 Prussian dollars charged on Silesia, and promised to respect the rights of the Catholics in Silesia. Saxony acceded to this peace, of which England and Russia were the guarantors.

Frederick II seized the opportunity of a peace to introduce useful institutions into the conquered territories, and to render his army more formidable. In 1743, on the death of the last count of East Friesland, he took possession of that county, the reversion of which had been granted to his family in 1644 by the emperor. The war of the Austrian Succession continued; the Emperor Charles VII was driven from his hereditary estates of Bavaria, and the Austrians were everywhere victorious. Frederick, apprehensive that an attempt would be made to recover Silesia, entered into a secret alliance with France (April 1744), and with the emperor, the palatinate, and Hesse-Cassel, in Frankfort (22 May 1744). He promised to support the cause of the emperor by the invasion of Bohemia, on condition that he should receive the circle of Königgrätz. He entered Bohemia suddenly, 10 Aug. 1744, and captured Prague; but the Austrians and Saxons compelled him to evacuate Bohemia before the close of the year. The death of the emperor (18 Jan. 1745), and the defeat of the Bavarians at Pfaffenhofen, obliged Maximilian Joseph, the young elector of Bavaria, to conclude the Peace of Fuessen with Maria Theresa, and occasioned the dissolution of the Alliance of Frankfort, after Hesse-Cassel had already declared itself neutral. The victory of the Prussians over the Saxons at Kesselsdorf, 15 Dec. 1745, led to the Peace of Dresden (25 December). Frederick retained Silesia, acknowledged the husband of Maria Theresa, Francis I, as emperor, and Saxony promised to pay 1,000,000 Saxon dollars to Prussia.

During the 11 following years of peace Frederick devoted himself with the greatest activity to the domestic administration, to the improvement of the army, and at the same time to the Muses. It was at this time that he wrote his 'Mémoires pour servir à l'Histoire de Brandenbourg,' his poem, 'L'Art de la Guerre,' and other works in prose and verse. He encouraged agriculture, the arts, manufactures, and commerce, reformed the laws, increased the revenues of the state, perfected the organization of his army which was increased to 160,000 men, and thus improved the condition of the state.

Secret information of an alliance between Austria, Russia and Saxony gave him reason to fear an attack and the loss of Silesia. He hastened to anticipate his enemies by the invasion of Saxony, with which the Seven Years' War, or third Silesian War, commenced. The Peace of Hubertsuburg (15 Feb. 1763), terminated this war without foreign interference, on the principle that the contracting parties should remain in *statu quo*. Frederick came out of the Seven Years' War with a reputation which promised him in the future a decisive influence in the affairs of Germany and Europe. His next care was the relief of his kingdom, drained and exhausted by the contests. He opened his magazines to furnish his subjects corn for food and for sowing. To the peasants he distributed horses for plowing, rebuilt at his own expense the houses destroyed by fire, established new settlements, built manufactories, and laid out canals. In 1764 Frederick founded the Bank of Berlin, with a capital of 8,000,000 Prussian dollars.

A treaty was concluded with Russia (31 March 1764), in consequence of which Frederick supported the election of the new king of Poland, Stanislaus Poniatowski, and the cause of the oppressed Dissidents in Poland. For the purpose of connecting Prussia with Pomerania and the Mark, and of enlarging and consolidating his territories, Frederick consented to the first partition of Poland proposed at Saint Petersburg and concluded 5 Aug. 1772. Frederick received the whole of Polish Prussia (which had been ceded to Poland by the Teutonic Order in 1466), with the part of Great Poland to the river Netz, excepting Dantzic and Thorn. From this time the kingdom of Prussia was divided into East and West Prussia. He declared against the possession of a large part of Bavaria by Austria in 1778, after the death of Maximilian Joseph, elector of Bavaria, without issue, but Austria was not to be diverted from her designs by negotiations. Saxony, therefore, formed an alliance with Prussia, and Frederick invaded Bohemia with two armies (July 1778). The Emperor Joseph, in a strongly fortified camp behind the Elbe, could not be induced to give battle. The aged Empress Maria Theresa wished for peace. But Catherine II having declared her intention of assisting Prussia with 60,000 men, this war of the Bavarian Succession was terminated without a battle by the Peace of Teschen (13 May 1779). Austria consented to the union of the principalities of Franconia with Prussia, and renounced the feudal claims of Bohemia to those countries. In the evening of his active life Frederick concluded, in connection with Saxony and Hanover, the confederation of the German princes, 23 July 1785.

Frederick left to his nephew, Frederick William II, a kingdom increased by 29,000 square miles, more than 70,000,000 Prussian dollars in the treasury, an army of 200,000 men, great credit with all the European powers, and a state distinguished for population, industry, wealth and science. Tested and strengthened by severe experience before he ascended the throne, and possessed of rare talents, Frederick shook the prevailing political system of Europe when he conceived and established, in accordance with the wants of his time, the confederation of princes, the master-work of his policy. One of his great merits is that in the most difficult circumstances he contracted no public debts, but on the contrary, though he distributed a considerable part of his revenues in different ways among his subjects, he had a richer treasury than any monarch in Europe ever possessed. His contempt for ecclesiastical establishments, which was considered by his contemporaries as a contempt of religion, has been censured, and his writings show that his heart was a stranger to the highest sentiments of piety. Entirely unacquainted with the literature and mental cultivation of Germany, which began in his later years, he underrated it and contributed nothing to its improvement, and was even prejudiced against the use of the language.

Some of Frederick's writings were published during his lifetime, but most of them appeared first in the 'Œuvres Posthumes' (1788–89). In 1846–57 the Berlin Academy published a critical edition of the whole, together with his literary and private correspondence, under the title 'Œuvres de Frédéric le Grand' (31 vols.). See FREDERICK THE GREAT.

Bibliography.— Loryman, 'Frederick the Great and the Seven Years' War' (1881); Carlyle, 'History of Frederick II' (1858–65); Tuttle, 'History of Prussia under Frederick the Great' (1888); Lavisse, 'La jeunesse du grand Frédéric' (1891); Lavisse, 'Le grand Frédéric avant l'événement' (1893); Koser, 'Friedrich der Grosse als Kronprinz' (1901); and 'Geschichte Friedrichs des Grossen' (4 vols., 1912–14); Daniels, E., in Vol. VI of 'Cambridge Modern History'; Reddenay, 'Frederick the Great and the Rise of Prussia' (1904).

FREDERICK III, king of Prussia, second emperor of modern Germany: b. Potsdam, 18 Oct. 1831; d. 15 June 1888. He married in 1858 the Princess Royal of England, the eldest daughter of Queen Victoria. When Prussia declared war against Austria in 1866 the crown prince, as he was called, became commander of the army of the Oder. By a series of rapid marches from Silesia through the Sudetic mountain passes into Bohemia his army arrived just in time to aid Prince Frederick Charles and snatched the decisive victory of Sadowa. At the outbreak of the Franco-German War he commanded the third German army, which numbered 200,000 men, and with these he advanced to attack the French under MacMahon. The first assault was made at Weissenburg (4 August), and two days later he successfully turned the French defense at Woerth, causing the disorderly retreat of MacMahon's army. He pressed northward closely after MacMahon, and the passage of the Meuse by the Germans under his command greatly contributed to the successful turning of the French advance and the final surrender at Sedan. This accomplished, he pushed on to Paris, and after surrounding the city established his headquarters at Versailles, where he remained until the capitulation in January 1871. In 1887 he was attacked by cancer, and while undergoing treatment for this his father died, and he became emperor in March 1888. The announcement of his own death three months later was received with wide regret, for his renown as a military commander, his liberal views, his large-heartedness and his resignation under suffering, had touched his personality with the rarest heroic qualities.

FREDERICK I («the Warlike»), elector and Duke of Saxony: b. 1369; d. 1428. His father was Frederick the Stern of Meissen. In 1381 on the death of his father he with his two brothers and two uncles succeeded to the inheritance. He became a distinguished soldier in the campaigns against the Hussites, and in recognition of his services was made elector and Duke of Saxe-Wittenberg in 1423 by the Emperor Sigismund. The Hussites inflicted a defeat upon him at Aussig in 1426. With his brother he founded the University of Leipzig. The House of Guelph, once rulers of England, were his direct descendants. Consult Böttiger and Flatte, 'Geschichte des Kurstaates und Königreichs Sachsen' (3 vols., Hamburg 1830–73).

FREDERICK I, elector and first king of Saxony: b. 1750; d. 1827. He was the son of Elector Frederick Christian and succeeded his father in 1763 as elector with the title of Frederick Augustus III. During his minority his uncle Prince Xavier was his guardian. With Frederick the Great he fought against Austria in 1778–79 and joined the League of German Princes. He declined the crown of Poland which was offered him in 1791. He kept his state neutral during the Franco-Austrian war of 1805, but in 1806 joined Prussia against France. The rout at Jena obliged him to form a treaty of alliance with Napoleon in the same year, and by it he was permitted to assume the title of royalty. He obtained the duchy of Warsaw in 1807 from Napoleon, and during the remainder of the latter's career remained his faithful ally. He was made a prisoner by the allies at Leipzig 19 Oct. 1813, and at the Congress of Vienna was obliged to cede about one-half of his kingdom to Prussia. He devoted his remaining years to perfecting the internal administration of his kingdom and developing its agricultural and commercial resources. Consult, Bonnefois, A., 'Un Allié de Napoléon, Frédéric Auguste premier roi de Saxe' (Paris 1902).

FREDERICK II («the Mild»), elector and Duke of Saxony: b. 1411; d. 1464. Son of Frederick I, he shared the family lands with his three brothers, defended Saxony from the Hussites, and became Burgrave of Meissen. His brother William disputed his partition of the lands of Frederick the Peaceful and the struggle went on from 1446 to 1450. An attempt to abduct his two sons was made in 1455; this is the event known to German history as the «Prinzenraub.»

FREDERICK III («the Wise»), elector of Saxony: b. Torgau, 17 Jan. 1463; d. 5 May 1525. He succeeded his father, Ernest, and is known chiefly as founder of the University of Wittenberg (1502), and as the friend and protector of Luther, one of the first professors of the new university. He refused to put into execution the papal bull which ordered Luther's writings to be burnt, and declined to put the reformer under restraint or be sent to Rome. It was by his arrangement that Luther, after the Diet of Worms, was seized and carried off to Wartburg. He did not, however, establish the reformed faith in his dominions. He became administrator of the empire in 1519, and was offered the imperial crown, but declined it.

FREDERICK III, king of Sicily: b. 1272; d. 1337. He was a son of King Peter of Sicily and Aragon. When his elder brother James succeeded as king of Aragon, Frederick became regent of Sicily. Soon afterward James surrendered Sicily to the Church in trust for Charles II of Aragon which caused a revolt of the Sicilians who chose Frederick as their king in 1296. Frederick was compelled to fight to hold his throne and in 1302 made a treaty with Charles II. With Henry VII he made war again on the House of Anjou in 1313 and the struggle was continued with short intervals to the end of his reign. During his reign the Sicilians became a united people, and were thenceforth to be reckoned with in the affairs of the peninsula.

FREDERICK I, William Charles, duke (1797–1803), elector (1803–06), and king (1806–16) of Würtemberg: b. Treptow, Pomerania, 6 Nov. 1754; d. 30 Oct. 1816. He was a son of Sophia Dorothea, niece of Frederick the Great. In 1797 he became duke. His title of king, with a large accession of territory, he gained through an alliance with Napoleon. In 1806 he joined the Confederation of the Rhine; in 1809, 1812 and 1813 fought for Napoleon, but in 1813 took side with the allies.

FREDERICK, Christian August, duke of Schleswig - Holstein - Sonderburg - Augustenburg: b. Castle Augustenburg, island of Alsen, 6 July 1829; d. Wiesbaden, 14 Jan. 1880. He was banished from Denmark in 1851, after having, while an officer of the general staff, taken part in the insurrection. Upon the conclusion of the war between Denmark and Germany in 1864, however, he was proclaimed duke by a popular assembly at Elmshorn and received allegiance at Kiel. But he was not destined to rule. The duchy by the terms of the Treaty of Vienna, fell to Austria and Prussia for disposal, and Prussia, through Bismarck, imposed upon Frederick conditions which he rejected. After the war with Austria, his domains were incorporated with Prussia. He took part in the Franco-German war as a Bavarian general on the general staff of the Prussian crown prince. His daughter, Augusta Victoria, was married to Prince William of Prussia, later William II, emperor of Germany.

FREDERICK AUGUSTUS II, king of Saxony: b. 1797; d. Tyrol, 9 Aug. 1854. He was the eldest son of Prince Maximilian of Saxony. He was made joint regent of Saxony with King Anthony in 1830 and succeeded the latter in 1836. With the aid of Prussian troops he quelled an insurrection which broke out in Dresden in 1849 in alarming proportions. The remainder of his reign was tranquil. His death resulted from a fall while traveling in the Tyrol. Consult Förster, F., 'Friedrich August II' (Leipzig 1910).

FREDERICK AUGUSTUS III, king of Saxony: b. 25 May 1865. He was educated at Leipzig and Strassburg, entered the army in 1883. He was made general of infantry in the Prussian army in 1902, and succeeded his father on 15 Oct. 1904. In 1902 the Princess Louise of Tuscany, whom he had married in 1891, eloped with André Giron, a tutor in his palace. She was divorced by him in 1903.

FREDERICK CHARLES, Prince of Prussia, popularly known as the «Red Prince»: b. Berlin, 20 March 1828; d. Castle of Klein-Glienicke, near Potsdam, 15 June 1885. He was a son of Frederick Charles Alexander and nephew of William I. He was in command of the first Prussian army which made so vigorous a resistance, and, aided by the second army, which arrived opportunely, finally defeated the Austrians at the battle of Sadowa (Königgrätz). In the Franco-German War he commanded the second army, fought at Vionville and Saint Privet, directed the siege-operations against Metz, and 28 Nov. 1870 defeated the army of the Loire. He married Marie Anna of Anhalt. One of his daughters, Louise Margareta (1860–1917) was married to Arthur, Duke of Connaught.

FREDERICK FRANCIS II, grand duke of Mecklenburg-Schwerin: b. 1823; d. 1883. He was the son of grand duke Paul Frederick and received his education at the University of Bonn. He succeeded to the grand duchy in 1842 and became a general in the Prussian army, distinguishing himself in the war with Austria in 1866. In 1870 he commanded the 13th army corps and laid siege to Toul, which he took 23 Sept. 1870, and later in the campaign he was prominent in the operations on the Loire and at the siege of Paris. There is a fine monument to him at Schwerin erected in 1893. Consult Von Hirschfeld, 'Friedrich Franz I' (Leipzig 1891).

FREDERICK HENRY, Prince of Orange: b. Delft, 1584; d. 1647. He was a son of William the Silent and succeeded his brother Maurice in 1625. The latter had given him his military training. He attained fame as a military leader by the capture of several cities including Hertogenbosch in 1629, Maastricht in 1632, Breda in 1637, and Sas van Ghent in 1644. He made a successful treaty with Spain securing for the Dutch every point for which they had long struggled. In his time the Dutch Republic reached its greatest power and influence. Consult 'Memoires de Frédéric Henri' (Amsterdam 1743).

FREDERICK LOUIS, Prince of Wales: b. Hanover, Germany, 20 Jan. 1707; d. Leicester House, London, 20 March 1751. He was the eldest son of George II, with whom he was on terms of enmity. He became the leader of the Opposition, which was strongly against Walpole and styled itself the Patriot party. In the contest between Handel and Buononcini he was a partisan of the latter. At the outbreak of the rebellion of 1745 he sought, but did not obtain, the command of the army. He married Augusta, daughter of Frederick II, duke of Saxe-Gotha, and his eldest son became King George III.

FREDERICK WILLIAM, elector of Brandenburg, called the Great Elector: b. 16 Feb. 1620; d. Potsdam, 9 May 1688. He succeeded his father when the unhappy Thirty Years' War was still raging in Germany, and his conduct toward the contestants was marked by great prudence. In 1641 he concluded a treaty of neutrality with Sweden, notwithstanding the earnest remonstrances of Austria. In 1644 he concluded an armistice with Hesse-Cassel, by which Cleves and the county of Mark were restored to him, and by the peace of Westphalia in 1648 received Magdeburg, Halberstadt and Kammin In the war between Poland and Sweden (in 1655) he supported both parties in turn and obtained an acknowledgment of the independence of the duchy of Prussia from Poland, upon whom it was formerly dependent. In 1672 he concluded a treaty with the Dutch Republic when his state was threatened by Louis XIV. On 6 June 1673, he concluded a treaty with France at Vossem, by which France promised to evacuate Westphalia and to pay 800,000 livres to the elector, who in return broke off his treaty with Holland

and promised not to render any aid to the enemies of France. In 1674 the German states declared war against France. In the following December a Swedish army, at the instigation of France, entered Pomerania and the Mark. The elector defeated them, 18 June 1675, at Fehrbellin. In 1678 he concluded a separate peace with France, at Nimwegen, as did also Holland and Spain. France demanded the restoration of all the conquered territories to Sweden. The elector, having refused compliance, formed an alliance with Denmark and waged a new war against Sweden, but was obliged to submit, by the Peace of Saint Germain-en-Laye, 29 June 1679. Louis XIV having occupied several circles of Alsace by his famous *chambres de réunion*, Frederick William effected (1684) an armistice of 20 years between France and Germany. But when he renewed (1685) his treaty with Holland and received into his dominions about 14,000 Protestant refugees from France, driven forth by the revocation of the edict of Nantes, new difficulties arose between him and France, which brought him into a closer connection with Austria. He received the circle of Schwiebus in 1686, and in the same year sent 8,000 men to assist the Austrians against Turkey. A wise and tolerant ruler, equally skilful in the fields of diplomacy and administration, Frederick William set himself to repair the ravages wrought by the Thirty Years' War. He paid great attention to agriculture, promoted canal works, was a discriminating patron of education, founded the University of Dinsburg and reorganized those of Frankfort on the Oder and Königsberg, and also established the Royal Library of Berlin. A colossal statue of Frederick William in bronze was cast by Jacobi in 1700 and is still one of the greatest ornaments of the city of Berlin. Consult Hitl, 'Der grosse Kurfürst und seine Zeit' (1893); Philippson, 'Der grosse Kurfürst' (1897–1902), and W. Ward's contribution in Vol. V of the 'Cambridge Modern History' (1908).

FREDERICK WILLIAM, duke of Brunswick: b. Brunswick, 9 Oct. 1771; d. at Quatre-Bras, 16 June 1815. He entered the Prussian military service in 1788, and in 1800 was commissioned major-general. With a Bohemian volunteer corps he invaded Saxony, and with Austrian reinforcements took Dresden and Leipzig. After the armistice of Znaim, he defeated Reubel's corps, 6,000 strong, at Oelger, near Brunswick, finally arrived at Elsfleth and Brake, seized all available shipping and embarked for England, where he was received with demonstrations of enthusiasm. He participated in the Peninsular War, and returned only after the battle of Leipzig (1813). He fell while leading an attack at Quatre-Bras.

FREDERICK WILLIAM I, last elector of Hesse: b. Philippsruhe, 20 Aug. 1802; d. Prague, 6 Jan. 1875. He succeeded to the throne in 1847. His reign was disturbed by conflicts with his people due to his efforts to disregard the constitution of 1831 and to limit popular liberties. In 1866 he took sides with Austria in the war with Prussia, was deposed, and for a time imprisoned. In the same year Hesse was annexed to Prussia, the larger portion of it now being incorporated with the province of Hesse-Nassau.

FREDERICK WILLIAM I, king of Prussia: b. Berlin, 15 Aug. 1688; d. Potsdam, 31 May 1740. He married the daughter of the elector of Hanover, afterward George I of England, and began to reign in 1713. In 1715 he declared war against Charles XII of Sweden, and in conjunction with Denmark took Stralsund; but on the death of Charles, in 1718, he made peace. Thereafter he introduced internal reforms in his kingdom and worked out an admirable system of financial administration. His habits were entirely military and he labored unweariedly to promote the discipline of his troops. One of his strongest peculiarities was an extraordinary love for tall soldiers; and in order to procure them had agents employed in all parts of Europe, who even went the length of kidnapping men for his service. He held science and literature in profound contempt; but money he worshipped; he was frugal in expenditures; and men of a military character after his own ideal he respected and encouraged. The consequence was that he left an abundant treasury and a well-appointed army of 83,000 men. He was succeeded by his son, Frederick the Great. Consult Carlyle's picturesque account of this sovereign in his 'Frederick the Great'; and Tuttle's 'History of Prussia' (Boston 1884).

FREDERICK WILLIAM II, king of Prussia: b. 25 Sept. 1744; d. 16 Nov. 1797. He was the eldest son of Prince August William, brother of Frederick the Great, and ruled from 1786 to 1797. Of an easy, pleasure-loving disposition in his youth, much under the control of his mistress, the Countess Lichtenau, and devoted to a blind obscurantism and Rosicrucian mysteries in his riper years, in his feeble hands the army declined and the power of Prussia waned. As the result of an interview at Pilnitz in 1791, he arranged with the emperor of Austria to interfere in aid of Louis XVI of France. The ensuing campaign was an inglorious one, concluded by a retreat to the Rhine in the autumn of 1792. The war was ended in 1795, and Frederick William ceded to France Prussian territory west of the Rhine. From the second (1793) and third (1795) partitions of Poland his kingdom obtained large accessions of territory. Consult Stanhope, 'A Mystic on the Prussian Throne' (London 1912).

FREDERICK WILLIAM III, king of Prussia: b. 3 Aug. 1770; d. 7 June 1840. He commenced his reign in 1797 by maintaining a strict neutrality in the various alliances with and against France which resulted from the ambitions designs of Napoleon I. In 1805, however, he yielded to the solicitations of Russia, and allied himself with the tsar against the French emperor. The rapid campaign of 1806, and the defeat of the Prussians at Jena, opened the gates of Berlin to the enemy, in whose hands it remained till 1809. In 1807 the battle of Friedland led to the humiliating peace of Tilsit. Restored to his capital, the king diligently endeavored to repair the evils of war; but new disasters overtook him, and his kingdom suffered greatly during the struggle from 1812 to 1814. He subsequently joined his troops with those of Russia. The allies having triumphed over the French at Leipzig, Frederick William in 1814 entered Paris with

Tsar Alexander. On the return of Napoleon from Elba, he once more joined the allies. After the victory of Waterloo, in which the Prussians, under Blücher (q.v.), played an important part, Prussia, once more at peace, gradually recovered from the losses she had sustained, under the wise and paternal sway of Frederick, whose moderation contributed greatly to the maintenance of peace. Throughout his life, he was a warm defender of the Protestant religion, and a patron of education. He never redeemed his promise, however, to bestow a representative constitution on his people, and the Revolution of 1830 only strengthened his determination to withhold it. The establishment of the provincial estates only affected his slightly absolute power. It may finally be said of him, that, a waverer between the Absolutist party and the Liberal party, he secured, as is the lot of most undecided men, the respect and adherence of neither.

FREDERICK WILLIAM IV, king of Prussia: b. 15 Oct. 1795; d. near Potsdam, 2 Jan. 1861. On the death of his father, Frederick William III, he succeeded to the throne in 1840. He evinced, at an early period, a love for the arts, which he preserved throughout his career. During the first years of his reign his subjects anxiously demanded the reform of the government, requiring the liberal constitution which had been promised them in 1815 in return for the great sacrifices they had made during the continental war. In 1847, at a general diet of the Prussian states, some of these reforms were granted. In March 1848, however, the king was obliged to change the ministry, to issue a general amnesty and commence a war in favor of Schleswig against Denmark. In the war between the western powers and Russia, the king preserved a strict neutrality, though earnestly solicited by each party to espouse its side in the conflict. In the complication relative to the Danubian principalities, Prussia followed the lead of France and Russia as opposed to England and Austria. Toward the end of 1857, a severe illness, resulting in the loss of some of his faculties, caused his brother William to be nominated regent, who succeeded him as king.

FREDERICK, Md., city and county-seat of Frederick County, one of the richest agricultural counties in the United States. Situated near the Monocacy River, on the Baltimore and Ohio and the Pennsylvania railroads; also the centre of the Hagerstown and Frederick Railroad, an extensive trolley system, 60 miles northwest of Baltimore and 58 miles north of Washington, D. C. Here are Hood College and Hood Seminary for Women and the Maryland School for the Deaf, a State institution. Frederick's manufacturing interests embrace leather, hosiery, brick, fibre brushes, flour, iron specialties, corn canning and lime products. The city has an assessed property valuation of $6,500,000, pure mountain water and good State roads. During the Civil War it was twice occupied by the Confederates, the second time in 1864 by Gen. Jubal Early, who compelled the citizens to pay a ransom of $200,000. Federal troops under General McClellan occupied the city in 1862. Frederick has monuments to Francis Scott Key, the author of the 'Star Spangled Banner,' and to Barbara Frietchie, the heroine of Whittier's famous war-time poem, which bears her name. Both were residents of Frederick and their remains are buried there. It was also the birthplace of Admiral Winfield Scott Schley, the hero of Santiago. Pop. about 10,411.

FREDERICK, Okla., city and county-seat of Tillman County, 150 miles southeast of Oklahoma City, on the Saint Louis and San Francisco and the Wichita Falls and Northwestern railroads. Owing to its position as the centre of a productive agricultural region, it has extensive interests in cotton, cottonseed oil and cake, alfalfa, wheat and poultry. The city owns its waterworks. Pop. 3,027.

FREDERICK THE GREAT. «A tyrant of extraordinary military and political talents, of industry more extraordinary still, without fear, without faith, without mercy» is Macaulay's estimate of the greatest of all the Hohenzollerns. In the light of the Great War, Macaulay's essay reads like prophecy, while Carlyle's glorification of unscrupulous force as embodied in Frederick seems like courting the destruction which burst upon the world in August 1914. All that Macaulay wrote about Frederick's great crime of violating his plighted faith, of robbing the ally whom he was bound to defend, and of plunging all Europe into «a long, bloody and desolating war» applies to Frederick's descendant; but Carlyle admired Old Fritz because he was the only man in the 18th century who managed *not* to be a hypocrite. Carlyle was a romantic historian, and his history of Frederick was his *magum opus.* That he should select this subject was almost the inevitable result of his German studies. Having acquired the language as a key to mineralogy, he translated various German works, wrote, in a series of essays, what is practically a history of German literature, and found in Goethe a working theory of life. With this vivid interest in everything German, it was only natural that Carlyle should be attracted by the military genius who made his little German kingdom great and formidable, and set it on its career of ever-growing power. To tell Frederick's story, Carlyle found it necessary to trace the history of his house from the earliest times. This was the greatest task of his life, and it set the pinnacle upon the edifice of his fame. It rounded out his literary life. Upon its completion, he received the honor he valued most, election as Lord Rector of his old university of Edinburgh, whither he had come a poor country boy of 13, more than 50 years before. In the hour of his greatest triumph came his greatest loss, the sudden death of his brilliant wife. He did no more work. His remaining years were a gradual declension to the grave.

Carlyle himself called his greatest work, his 'Thirteen Years War' with Frederick. In 1852 he made his first trip to Germany to gather material, visiting the scenes of his hero's battles and noting their topography with unerring accuracy. The first two volumes appeared in 1858 and the last two in 1865.

Emerson considered it «Infinitely the wittiest book that was ever written.» Lowell criticized it with discrimination. While pointing out its obvious faults, he wrote: «The figures of most historians seem like dolls stuffed with bran, whose whole substance runs out through any hole that criticism may tear in them; but Carlyle's are so real in comparison, that, if you prick them, they bleed.»

So true are Carlyle's narratives of Frederick's battles, that his work was studied as a textbook in the military academies of Germany.

ARCHIBALD MACMEACHAN.

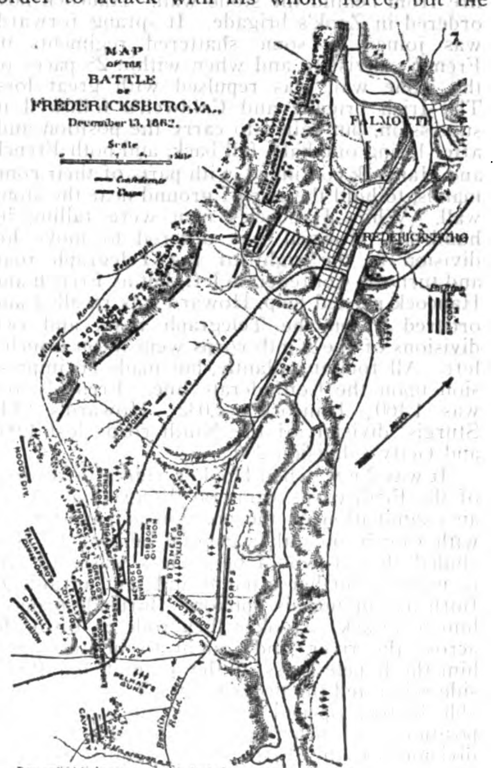
FREDERICKSBURG, Tex., town, county-seat of Gillespie County; on the San Antonio and Arkansas Pass Railroad; 80 miles west of Austin. It was founded by a German colony in 1846. Chief industries, farming and stock-raising. Number of inhabitants in 1917 somewhat more than 3,000.

FREDERICKSBURG, Va., city in Spottsylvania County; on the Rappahannock River, and the Richmond, Fredericksburg and Piedmont, and the Potomac, Fredericksburg and Potomac railroads; 61 miles north of Richmond. It has good water power and manufactures silk, woolen goods, flour, shoes, carriages, tanned leather, excelsior, etc., and an assessed property valuation of more than $2,000,000. It was the scene of several battles during the Civil War. (See FREDERICKSBURG, BATTLE OF). Noteworthy are the Stonewall and National cemeteries, Fredericksburg College, State Normal School, public libraries, an attractive park, etc. Pop. 5,874.

FREDERICKSBURG, Battle of. At the beginning of December 1862 the Army of the Potomac, under command of General Burnside, held the north bank of the Rappahannock River at Falmouth, Va., while the Confederate Army, under General Lee, held the south bank at and below Fredericksburg. The Army of the Potomac «present and equipped for duty» numbered 120,281 men, with 312 guns. General Lee's army, strongly entrenched on a broken range of hills back of Fredericksburg, numbered (10 December) «present for duty» 78,513 men, with 270 guns.

The Army of the Potomac was organized into three grand divisions: The right, under General Sumner, consisted of the Second corps, General Couch, the Ninth corps, General Willcox, and Pleasonton's cavalry division; the centre, under General Hooker, of the Third corps, General Stoneman, Fifth corps, General Butterfield and General Averell's cavalry division; the left, under General Franklin, of the First corps, General Reynolds, Sixth corps, General Smith, and General Bayard's cavalry brigade. General Lee's army was divided into two wings, General Longstreet commanding the left and General Jackson the right.

Burnside concluded to cross the river at and below Fredericksburg by pontoon-bridges. Under great difficulties, with annoyance from the enemy, the bridges were completed 11 December, troops rushed over, and by night of the 12th Sumner and Franklin had crossed and taken position. Franklin, who was to open the battle by an attack upon the Confederate right, reinforced by Birney's and Sickles' divisions of the Third corps, and Burns' of the Ninth, had about 60,000 men. At 7:30 A.M. on the 13th, Burnside gave him orders to seize the heights at Hamilton's crossing. One of Franklin's smallest divisions, Meade's, led the attack, moving out at 9 o'clock; but owing to flank attacks and lack of immediate support, it was 1:15 P.M. before Meade drove the Confederates from the Richmond Railroad and, crossing it, charged up a ridge and into the woods, piercing the centre of A. P. Hill's first line; but when he had crossed the road that ran in rear of the crest he was attacked, front and flank, by Hill's second line and the reserves, and was driven back with a loss of over 40 per cent in killed, wounded and captured. Gibbon, who had been thrown forward to support Meade's right, shared the same fate, being forced back, with a loss of 1,267 men. The Confederates then advanced beyond the railroad but were checked. Franklin made no further attempt to carry the ridge, but directed his attention to protecting his left, which he thought was seriously threatened. At 2:30 P.M., when Sumner was heavily engaged in front of Marye's Heights, Franklin received Burnside's order to attack with his whole force, but the



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order was not carried out. Franklin put but a small part of his command into the fight.

Sumner was held in position until after 11 A.M. in the expectation that Franklin would make such an impression upon Lee's right as would enable him to carry the line near the Telegraph and Plank roads. Feeling the importance of haste, Burnside now directed Sumner to begin his movement. In rear of the town, and between it and the heights that Sumner was to carry, was a broken plain, traversed about midway by a canal or ditch, running from right to left. Two roads cut the plain nearly at right angles with the canal; the Plank road on the right, the Telegraph road on the left, leading to Richmond. The advance was to be made on and between these two roads, over ground completely covered by artillery on the heights. McLaws' division held the heights to be assaulted, Cobb's and Kershaw's brigades being placed in the sunken Telegraph road, that ran at the base of the hill. On the side of the road next to the town was a stone wall, shoulder high, behind which Cobb's and Kershaw's men were well protected. The Second corps led in the attack. French's division moved out of the town by parallel streets, and at noon, under a severe artillerv and musketry fire, had driven in the Confederate skirmishers and gained a rise of ground, within about 120 yards of the stone wall, from which and the top of the hill it received a most deadly fire. Hancock's division followed in support. At 1 P.M. Couch ordered French and Hancock to carry Marye's Heights. French sent in his three brigades in succession, but they were bloodily repulsed by the deadly fire from behind the stone wall. Hancock now ordered in Zook's brigade. It sprang forward, was joined by some shattered regiments of French's division, and when within 25 paces of the stone wall was repulsed with great loss. The Irish brigade and Caldwell's followed in succession, but failed to carry the position and, after losing one-half, fell back, and both French and Hancock continued, with parts of their commands, to hold the rise of ground near the stone wall. While Hancock's men were falling by hundreds, Howard was ordered to move his division to the right of the Telegraph road and turn the Confederate left, but as French and Hancock needed help, Howard was recalled and ordered in on the Telegraph road, and two divisions of the Ninth corps went in on Couch's left. All fought gallantly, but made no impression upon the Confederate line. French's loss was 1,160; Hancock's 2,032; Howard's 914; Sturgis' division of the Ninth corps lost 1,007 and Getty's division 296.

It was 2 P.M. when Hooker, riding in advance of the Fifth corps, came on the ground. After an examination of the position and conference with Couch and other general officers, he concluded that it would be useless waste of life to make a further attempt and sent an aide to Burnside, giving his opinion. Burnside ordered him to attack. Hooker then rode to Burnside, across the river, and sought to impress upon him the hopelessness of the attempt, but Burnside reiterated the order to attack. Every available battery opened fire upon the Confederate position, and near sunset Humphreys led his division of the Fifth corps against Marye's Heights, Sykes' division moving on his right. Twice Humphreys led his men forward; some of them were killed within 20 yards of the stone wall; but he was repulsed with a loss of 1,000 men. Sykes, on his right, lost over 200, while Griffin's division, on the left, supporting the Ninth corps, lost over 800 men. Night came with the Union army everywhere repulsed. Burnside directed preparations for a renewal of the battle on the morning of the 14th, when he proposed to lead the Ninth corps, his old command, in an assault where the 2d and 5th corps had failed, but he was dissuaded from the attempt. From the night of the 13th until the night of the 15th the two armies confronted each other, engaged in artillery-firing and angry skirmishing. On the night of the 15th the Army of the Potomac recrossed the river, after one of its most bloody and humiliating defeats. Its loss was 1,284 killed, 9,600 wounded, and 1,769 missing, an aggregate of 12,653. The Confederate loss was 595 killed, 4,061 wounded, and 653 missing, an aggregate of 5,309. The loss of the Confederate troops defending Marye's Heights was less than 1,000; that of the attacking and supporting Union troops was over 7,300. As a result of the large Federal losses both General Franklin and General Burnside were much criticized especially after the Joint Committee of Congress on the Conduct of the War had made a report unfavorable to both. General Franklin resigned, though he maintained that the fault was not his, but the result of Burnside's inadequate orders. A considerable controversy arose regarding this question, but the preponderance of evidence seems to place the blame on Burnside's shoulders. General Burnside soon after the battle of Fredericksburg was relieved by General Hooker. A number of other engagements and military operations of varying extent took place at or near Fredericksburg on April 17–19, 1862, Aug. 4–8, 1862; Nov. 9, 1862; April 29–May 4, 1863; March 5–8, 1865; by some authorities the fighting on May 3–4, 1863, is called the second battle of Fredericksburg, but it is usually known as the battle of Marye's Heights, being part of the Chancellorsville campaign (q.v.). Consult

Alexander, E. P., 'The Battle of Fredericksburg' (in Southern Historical Society Papers, Vol. X, pp. 382 and 445, Richmond 1882); Allan, W., 'The Army of Northern Virginia in 1862' (Boston 1892); Chamberlain, J. L., 'The Passing of the Armies, etc.' (New York 1915); Confederate States of America, War Department, 'Reports of the Operations of the Army of Northern Virginia, 1862–63' (2 vols., Richmond 1864); Conway, M. D., 'Fredericksburg, First and Last' (in *Magazine of American History*, Vol. XVII, pp. 185 and 449, New York 1887); French, S. L., 'The Army of the Potomac from 1861–63' (New York 1906); Gough, J. E., 'Fredericksburg and Chancellorsville' (London 1913); Greene, J. L., 'Gen. W. B. Franklin and the Operations of the Left Wing at the Battle of Fredericksburg' (Hartford 1900); Henderson, G. F. R., 'The Campaign of Fredericksburg, November–December 1862' (London 1891); Humphreys, B. G., 'Recollections of Fredericksburg' (in 'Southern Historical Society Papers,' Vol. XIV, p. 415, Richmond 1886); Johnson, R. U., and Buel, C. C., editors, 'Battles and Leaders of the Civil War' (4 vols., New York 1887–88); Palfrey, F. W., 'Campaigns of the Civil War: The Antietam and Fredericksburg' (New York 1893); Powell, W. H., 'History of the Fifth Army Corps, etc.' (New York 1896); Redway, G. W., 'Fredericksburg' (London 1906); Ropes, J. C., 'The Story of the Civil War' (Part II, New York 1898); Stine, J. H., 'History of the Army of the Potomac' (Washington 1893); Swinton, W., 'Campaigns of the Army of the Potomac' (New York 1866); United States, Conduct of the War, Joint Committee on the, 'Report on the Battle of Fredericksburg' (37th Congress, 3d Session, Senate Reports, No. 71, Washington 1863); United States, War Department, 'War of the Rebellion. Official Records' (Series I, Vols. XXI, XXV, LI; Series II, Vol. V; Series IV, Vol. II; Atlas, Washington 1888–1900); Walker, F. A., 'History of the Second Army Corps in the Army of the Potomac'

(New York 1891); Wise, G., 'Campaigns and Battles of the Army of Northern Virginia' (New York 1916).

FREDERICKTOWN, Mo., city and county-seat of Madison County, 104 miles south of Saint Louis, on the Saint Louis, Iron Mountain and Southern Railroad. Marvin College is situated here. There is a lead mine known as La Motte located nearby. It has been worked continuously for over 200 years. Cobalt, lead, nickel and copper mining are carried on and railroad ties are manufactured. The city owns its electric-lighting plant. Pop. 2,632.

FREDERICTON, Canada, county-seat of York County and capital of New Brunswick, is beautifully situated on the west side of the river Saint John, 60 miles north-northwest of Saint John. It is on the Canadian Pacific and Intercolonial railways, and is the terminus of the Fredericton Railway. It is a port of entry and the seat of a United States consular agent. It has handsome public buildings and is the seat of parliament buildings, New Brunswick University and of the provincial normal school. It is the seat of an Anglican bishopric. Fredericton has manufactories of iron castings, machinery, leather, boots and shoes, but its chief trade is in lumber and timber products. The city was first called Saint Ann's, and on its being selected as the site of the provincial capital by Col. Thomas Carleton, the first lieutenant-governor, the name was changed (1785) to Fredericton, in honor of the Duke of York. Pop. 7,208.

FREDERIKSBERG, Denmark, formerly a suburban municipality of Copenhagen, situated to the west of the latter. It is a handsome residential section and contains several beautiful parks and a zoological garden and art museum. It contains also a palace built by Frederick IV in the 18th century. It is in the Italian style and is now used as a military training college. The Royal Porcelain Works, a faïence factory and several breweries are located also in this section. Since 1910 it forms a part of Greater Copenhagen. Pop. 97,237.

FREDERIKSBORG, frād'ĕr-ĭks-bôrg, celebrated castle of Denmark, situated on islands in Frederiksborg Lake in Zealand, 22 miles northwest of Copenhagen. It was constructed in 1600–20 by Christian IV and is in the style of the Danish Renaissance. The kings of Denmark were fomerly crowned in its chapel, which contains a king's oratory and several religious paintings executed by Bloch. The mural decorations of the castle are by Ovens, and De Vries and Sweis executed most of the sculpture. The castle was partly destroyed by fire in 1859 and has since been made into a national historical museum.

FREDERIKSHALD, frād'ĕr-ĭks-häl', Norway, fortified seaport, on the Idefjord, at the embouchure of the Tistedalselo, 85 miles southeast of Christiania. It has a good harbor which is protected by the fortresses of Frederiksten and Glydenlöve. There is a monument to Charles XII who fell while besieging the town in 1718. It was besieged by the Swedes for two years in 1658–60. It is of importance as a centre for the lumber trade of East Norway and exports large quantities of woodenware. Pop. 11,992.

FREDERIKSHAVN, frā'dĕr-ĭks-hä'v'n, Denmark, seaport town of Jutland, on the Cattegat, 52 miles north of Aalborg. The harbor is excellent, admits vessels of 20-feet draught and is free from ice throughout the year. There is regular steamer communication with Copenhagen and with several points in England and Sweden. It exports large quantities of dairy products, beef, fish, oysters, pork and eggs, and imports coal, iron, cotton goods, grain, yarn and wood. It was incorporated as a town in 1818. Pop. 7,916.

FREDERIKSTAD, frā'dĕr-ĭks-stät, Norway, seaport town at the mouth of the Glommen, 58 miles southeast of Christiania. It dates from 1570 and was for a long time very strongly fortified. Its industries are important, consisting of manufactories of bricks, boilers, engines, chemicals, cotton and woolen goods, lumber and ships. The lumber trade with France, Germany and Holland is extensive. In the neighborhood is Hankö, one of Norway's most popular bathing resorts. Pop. 15,597.

FREDMAN, The. See Bellman, Karl Mikael.

FREDONIA, Kan., city and county-seat of Wilson County, on the Atchison, Topeka and Santa Fé and the Missouri Pacific railroads, on the Fall River, 90 miles southeast of Wichita. It is situated in an agricultural and stock-raising district and natural gas and oil are found nearby. The chief industries are manufactories of brick and cement, window-glass and ice, linseed-oil and founding. The waterworks are owned municipally. The commission form of government obtains here. Pop. 3,473.

FREDONIA, N. Y., village in Chautauqua County, on the Dunkirk, Allegheny Valley and Pittsburgh railroad, about four miles south of Dunkirk and about 45 miles southwest of Buffalo. It was settled in 1803 and incorporated as a village in 1829. It was early noted for its good schools, including its free academy. It is a residential village situated in an agricultural region, in the Lake Erie grape section, and has large wine cellars, nurseries, canning establishments, etc. Some of the industrial products are grape baskets and boxes, dried fruits, patent medicines and grape juice. Natural gas was discovered here in the early part of the 19th century and was in use for lighting the village in 1821. The trade is chiefly in fruits, wine and patent medicines. It has the D. R. Barker free library and one of the State Normal schools. It was for some years the home of William Barker Cushing (q.v.). The village owns and operates the waterworks and electric-light plant. Pop. 5,328.

FREDRO, frā'drō, Count **Alexander**, Polish dramatist, called «the Molière of Poland»: b. Suchorow, Galicia 1793; d. Lemberg, 15 July 1876. He served in the army for many years and came to Paris in 1814 to study French drama. He was the founder of Polish comedy, those who preceded him having worked over French plays. He produced 18 comedies, which had considerable success. He is praised for his presentation of comic types and for the national spirit which pervades his work. His plays appeared in a collected edition in 1877. 'Mr. Moneybags' (his first piece, 1821); 'Ladies and Hussars'; 'Man and Wife'; and

'Revenge', are his principal titles. The scenes are taken from real life.

FREE BANKING SYSTEM, the predecessor of and essentially the same as our present national banking system, and on the same principles as the general railroad and corporation laws. Up to 1838 all banks required special charters, with the attendant evils of collusive «blanket» powers, corruption, and an insecurity which was not only a private evil, but seriously affected the State credit and finance. In that year New York State passed a «free» or open banking law, under which anyone could start a bank by depositing with the State an amount of securities equal to its circulating notes. The other States soon followed the precedent.

FREE CHURCH, the term applied by British non-conformists to the Christian denominations throughout the British Empire, free from state patronage and control.

FREE CHURCH ASSOCIATION, founded in 1866, in English ecclesiology, is a society which has for its main object the abolishment in the Established Church of pew rents and pew ownership, maintaining the equal right of all parishioners to the free and unrestricted use of seats in churches. See INSTITUTIONAL CHURCH.

FREE CHURCH OF ENGLAND, a distinct evangelical Protestant denomination which originated in the creation of «free churches» in the west of England as a protest against the Tractarian (q.v.) movement of 1832. The Shore controversy (1843–49), and the Gorham case (1849–50), accentuated the movement. The Church had in 1916 two bishops, 24 ministers and 1,352 members. This Church may be regarded as the English counterpart of the Reformed Episcopal Church in the United States (q.v.).

FREE CHURCH OF SCOTLAND. This was the name assumed by the large body of ministers and their adherents who gave up their livings and separated from the Established Church of Scotland at the Disruption (q.v.) on 18 May 1843. They seceded in vindication of the «Headship of Christ,» that is, to gain liberty to obey what they deemed the will of their Divine Lord in all church arrangements (including the election of ministers to charges) free from the control or interference of the civil power. No new article of faith was adopted, all the forms and rights of the national Church being retained in their integrity. The Church prospered in the face of formidable financial difficulties which were largely overcome by the institution of a sustenation fund, and by the excellent arrangements made for its distribution and employment. After 1867 there was a movement for an incorporating union with the United Presbyterian Church, which represented the voluntary principle in Scottish non-conformity. That union was formally compelled by the constitution at Edinburgh, on 31 Oct. 1900, of the first general assembly of the United Free Church of Scotland, which represented 1,149 ministers and 296,089 communicants belonging to the Free Church, and 637 ministers and 199,089 belonging to the United Presbyterian Church. A protesting minority, consisting of 27 ministers and 500 elders, who claimed to represent a total strength of 50,000 members and adherents, refused to join the union. The union of the Free Church with a voluntary body appeared to them to be a surrender of the principle of national religion and of the Confession of Faith, subscription to which had been already qualified by two declaratory acts. They were also opposed to the toleration in the Church of the higher criticism, and to the use of organs and human hymns. They were extruded from the use of the buildings and funds of the Church; the parties went to law; and after the protesting minority had been nonsuited in the Scottish courts, the case was taken on appeal to the House of Lords, which by a majority judgment, given in August 1904, reversed the decision of the Scottish courts. The effect of the judgment was that the whole of the funds and property of the Free Church became vested in the non-uniting minority, or «Wee Frees,» as they were popularly called. Lord Halsburg, who gave the leading judgment, decided that the Free Church had «lost its identity» in its incorporation with the United Presbyterian Church, a voluntary body. The decision was received with dismay and indignation in Scotland. It was at once perceived that the «legal» Free Church, whose stronghold was in the Gaelic-speaking Highlands and Islands, and was almost totally unrepresented alike in the rural districts throughout the country and in the great urban centres, was in no position to administer the trust that had been imposed upon it. Relief had to be sought in legislation; a royal commission was appointed and following on its report an act of Parliament was passed in 1905, under which an executive commission was set up to allocate the property as between the two churches. The Free Church had in 1916 5 synods, 12 presbyteries, 97 ministers and 178 congregations. See PRESBYTERIANISM, *United Free Church*.

FREE CITIES, the name applied to various cities of Germany which in the 12th century assisted the emperors in repressing the arrogance of the nobles, and, in return for their services or contributions, received various privileges and immunities and became imperial cities. Free cities existed in Germany from the time of the Romans; they had little in common with the free cities of later times, and in the beginning of the 16th century lost their most essential privileges, and even the name of free cities, through the ignorance and carelessness of their magistrates. The most important of those privileges, as shown in the case of Ratisbon, were that they should enjoy an independent government; should never swear allegiance to any emperor or king, nor be obliged either to engage in any expedition against the Romans, or to pay for the privilege of exemption; nor to pay any contributions whatsoever to the empire; nor be in any way reckoned among the cities of the empire. Virtually they were independent republics. Commerce and manufactures gradually increased the importance of the imperial cities and they often ventured to resist their masters, the emperors, and could not be reduced to obedience without great difficulty. In the middle of the 13th century two important confederacies were established for common objects — the Hanseatic League (q.v.) (1241), comprising the cities of Frankfort-on-the-Main, Hamburg, Bremen and Lübeck, and the league of the

Rhenish cities (1246), comprising Cologne, Worms, Mainz, Strassburg, Basel and Spires, which are now incorporated in their respective political divisions. The powerful Hanseatic League lasted nearly four centuries, until its dissolution was effected by several causes in 1630. The remnant of this league and of the former *collegium* of cities, which had its representatives in the German Diet — namely the free cities of Hamburg, Bremen and Lübeck — was incorporated with the French Empire in 1810. As these cities co-operated vigorously in the recovery of German independence, they were acknowledged, together with Frankfort-on-the-Main, as free cities by the Congress of Vienna (1814–15). They joined the German Confederacy and obtained the right of a vote each in the Diet, and one among the four in the narrower council. In conformity with the 12th article of the constitution of the German Confederacy, they established a common Supreme Court of Appeal in 1830. Frankfort in 1866 was annexed to Prussia. The only free cities now existing are Hamburg, Lübeck and Bremen, each sending a member to the Bundesrath, and Hamburg three deputies to the Reichstag, the others one each.

FREE CONGREGATIONS (Ger. *Freie Gemeinden*), sometimes called "Protestant Friends," a sect of German Rationalists, who at first professed to be Christians, but now reject the doctrines of miraculous revelation and a personal deity. They possessed considerable influence between 1840–50. From 1855 on, they had a difficult time as a result of determined oppression on the part of the governmental authorities of most of the German states. In more recent times they again increased their influence, gained official acknowledgment in a number of states, and gradually extended the number of their adherents. In 1859 a national society of free congregation was formed. A number of weekly and monthly journals are published, representing their views. There are upwards of 120 congregations of them in Germany, and a few in the United States. Consult Kampe, F., 'Geschichte der Religiösen Bewegung der Neueren Zeit' (4 vols., Leipzig 1852–60); Nippold, F., 'Handbuch der Neuesten Kirchengeschichte' (Heidelberg 1867); Tschirm, G., 'Zur 60 jährigen Geschichte der Freireligiösen Bewegung' (Bamberg 1904).

FREE ENQUIRERS, a body of reformers interested in the improvement of labor conditions and associated with the establishment of New Harmony, Ind., in 1825. The originator of the movement was Robert Owen (q.v.), and among others associated with him was Robert Dale Owen (q.v.) who with Fanny Wright at New York in 1827, established *The Free Enquirer*, a socialistic and agnostic publication. See NEW HARMONY; HARMONISTS; D'ARUSMONT, MADAME FRANCES (FANNY WRIGHT); RAPP, JOHANN GEORGE.

FREE NEGROES, in the United States. At the formation of the Union these numbered about 60,000, nearly half of them in the South; but while there were few slaves in New England, and those dwindling, and less than 50 per cent more than the free colored population north of Maryland, the South had more than 20 times as many slaves as freedmen, and the system was extending. Hence this section began early to dread the free negroes, as an element always making their slaves discontented, and possibly stirring them to revolt; a sentiment deepened into terror after the Santo Domingo massacres. State laws and constitutions were framed or amended to drive them from the States or re-enslave them; one method being to forbid emancipation by will, and provide that free negroes must choose masters or leave the State; and another to punish all penitentiary offenses of negroes with reduction to slavery. The Colonization Society derived its first impetus from this feeling, till it was seen to be a mere reinforcement of slavery. The laws for refusing to allow negro merchant sailors to land, or even imprisoning them if they did, also caused much bad blood with the North. The "Black Laws" reached their acme just before the War, as did the personal-liberty laws in the free States. When the United States Constitution was formed free negroes could become voters in every one of the original 13 states except South Carolina and Georgia. By 1860 they had lost this privilege in all but five New England States and New York. This remained so until the passing of the 13th, 14th and 15th amendments to the Constitution. At the beginning of the Civil War there were 487,970 free negroes to 3,953,760 slaves. (See NEGRO). Consult Alexander, W. T., 'History of the Colored Race in America' (New Orleans 1887); Brawley, B. G., 'A Short History of the American Negro' (New York 1913); Russell, J. H., 'The Free Negro in Virginia, 1619–1865' (in Johns Hopkins University 'Studies in Historical and Political Science,' Series XXXI, No. 3, Baltimore 1913); Williams, G. W., 'History of the Negro Race in America' (New York 1883).

FREE PORT, a harbor where ships of all nations may enter and load or unload on payment of harbor dues or charges for accommodation. Goods may be stored at free ports, and may then be either reshipped for export, or they may be admitted for home consumption on payment of the usual full customs of the country. The bonded warehouse system effects the same end as free ports. It is gradually spreading. England never had any free ports. There are none to-day in the United States and France. Only Hamburg and Bremen in Germany and Copenhagen in Denmark are still partially free ports. There were, however, many free ports in earlier times when the large number of small states with differing custom regulations made them of importance. Consult Bellet, D., 'La Question des Zones et Ports Francs' (in *Revue d'Économie Politique*, Vol. XXXI, p. 197, Paris 1917); Howe, F. C., 'The Free Port an Agency for the Development of American Commerce' (in *American Academy of Political and Social Science*, Vol. LIX, p. 236, Philadelphia 1915).

FREE PRESS. See PRESS, FREEDOM OF THE.

FREE SHIPS, FREE GOODS. That is, that in time of war, belligerents shall have no right to inquire into anything regarding a vessel and her cargo but whether the former belongs to a neutral, and if so, her cargo must be as free as herself; unless the cargo is agreed contraband of war. This is the doctrine of international law which the countries of predominantly industrial interests have always struggled to have accepted; while those by nature constantly or frequently at war have refused to admit it. In the great wars of France with England, in the Revolutionary and Napoleonic era, the United States was the great champion of this doctrine, while England refused to admit it, claiming the right to confiscate her enemy's goods wherever she found them, and search every neutral for them. The War of 1812 arose partly from this, and did nothing toward settling it; but the close of the war period left it of little practical importance for many years. The Declaration of Paris (q.v.) went farther than this, and proclaimed neutral goods safe even in an enemy's vessels.

FREE AND SLAVE LABOR. See LABOR.

FREE-SOIL PARTY (1848–55). This was the old Liberty party (q.v.) of direct abolition (Birney, Chase, etc.), plus the «Conscience Whigs» of Massachusetts (Sumner, C. F. Adams, etc.), who supported the Wilmot Proviso (q.v.), and the «Barnburners,» or Van Buren section of the New York Democrats. The latter as a body adopted their principle of restricting the extension of slavery into the Territories, to punish the Polk administration, ultra-southern, for attempting to build up its own «machine» in New York at the expense of the Albany Regency (q.v.); but a small element of it was really in sympathy with their less extreme purposes. Van Buren had lost the nomination in 1844 by refusing to approve the annexation of Texas; and his co-operation was more than a mere party move. The Liberty party in 1847 nominated John P. Hale of New Hampshire and Leicester King of Ohio for President and Vice-President; but seeing a chance of larger success through the promising split in the Democracy, dropped them and waited. The Barnburners offered only an even share of the State vote with their rivals the Hunkers in the Baltimore Democratic convention of 1848, withdrew, and after nominating Van Buren at a bolting convention to keep the party together, agreed to join in a fusion «Free-Soil» party. A convention of this at Buffalo in August nominated Van Buren and Adams. The platform declared for «Free Soil, Free Speech, Free Labor and Free Men»; and that slavery in the States was beyond the control of Congress, but that as Congress could not make slaves it was bound to refuse it admission to the Territories. (See WILMOT PROVISO). The party cast 291,263 votes, turned Maine and six western States over to the Democrats (Cass), and would have defeated the Whigs (Taylor) but that the New York defection (120,510) was mainly from the Democrats and gave that State to the Whigs. The New York Democratic delegation to Congress was annihilated all but one; and the two factions at once struck a bargain which left Van Buren permanently out of public life. The Free-Soilers in the 31st Congress (1849–51) had 2 United States senators (Chase and Hale), and 14 representatives, including J. R. Giddings, George W. Julian and Horace Mann. Sumner in the Senate and 3 more representatives reinforced them in 1851, and in the 33d Congress (1853–55) they had 5 senators and 17 representatives. Having been abandoned by their casual allies, in 1852 they nominated Hale and Julian; with a platform denouncing the Compromise of 1850 (q.v.), both the great parties for accepting it, and slavery as «a sin against God and a crime against man,» and demanding the repeal of the fugitive-slave law. They polled 156,149 votes, of which 25,329 were in New York. They maintained their organization in Congress till the Kansas-Nebraska Bill (q.v.) had created the Republican party, which adopted its policy, and into which they were at once fused. It had served as a school of experience for some of the most distinguished Republican leaders, and played a part out of all proportion to its voting strength. Consult Wilson, H., 'Fall of the Slave Power' (New York 1874); and Smith, T. C., 'Liberty and Free-soil Parties in the Northwest' (New York 1897).

FREE SONS OF ISRAEL, Independent Order of, a Jewish fraternal and benevolent society founded 10 Jan. 1849. It has 3 grand lodges and 89 subordinate lodges in the United States. In 1914 it had a total membership of 8,745, and up to that time had paid $6,559,355 to its beneficiaries.

FREE SPIRIT, Brethren of the, a sect of heretics with strong leanings toward quietistic and pantheistic mysticism, which originated in Alsace in the 13th and 14th centuries, and quickly became disseminated over Italy, France and Germany. They claimed «freedom of spirit,» and based their claims on Rom. viii, 2–14. Thence they deduced that they could not sin. Consult Döllinger, J. J. I. von, 'Beiträge zur Sektengeschichte' (Munich 1890); Hahn, C. U., 'Geschichte der Ketzer' (Stuttgart 1847); Lea, H. C., 'History of the Inquisition of the Middle Ages' (3 vols., New York 1888); Preger, W., 'Geschichte der Deutschen Mystik' (3 vols., Leipzig 1874–93).

FREE STONE, the name applied to building stones, especially sandstones, that can be most conveniently worked on account of their freedom from stratification planes, layers of heterogeneous material or different structure, etc. Limestones that can be freely cut in all directions, owing to exceptional homogeneity of structure, may also be called free stone. See BUILDING MATERIAL.

FREE TRADE, in current use restricted to mean the interchange of commodities between countries politically independent, without obstacles specifically intended to restrict the trade. All taxes on imports, which form a large part of the revenue of most civilized governments to that extent impede the freedom of trade; but the essence of the free-trade system is, that they shall not be arranged to «protect» the correspondent home production, or, as free-traders would put it, to divert capital into otherwise unprofitable channels at the expense of the consumer. This is accomplished by selecting articles not possible to produce at home (as tropical products in a temperate country); by forbidding their production at home (as tobacco in England), foregoing certain new home industries for the sake of sparing existent ones; or by laying corresponding internal taxes.

That free trade was never even formulated as a theory till a few generations ago, nor adopted as a policy till within two generations, that it is even now practised in its fulness by only one country, and nearly so by only two more, and that the former, its chief exponent, is at this moment rent by a fierce struggle to resume its old protective system, indicates something more back of this question than the mere state of economic enlightenment. The truth is, free trade is a matter of business, and all states have prior interests which business only subserves, and to which it is sometimes partially antagonistic. National existence always comes first, national prestige usually, national rivalry and jealousy frequently. In the Middle Ages war was the normal condition of most countries and the constant liability of the rest; hence everything had to be subordinated to diversified resources in war, whence a nation's supplies might be suddenly shut off. As the age of neutrality and the localization of wars has supervened, this danger has practically passed; but masses of capital and of labor in each country, which its rulers cannot politically disregard, can still be injured by the hostile tariffs which are the modern substitutes for fleets and armies of conquest. The problem at issue is, whether these injure the target as much as the marksman; free-traders have one answer, protectionists another. But the protectionist interest is always much more concentrated and effective than the free-trade: it is that of masses of capital embarked in certain enterprises and fighting for life, with all the masses of people behind it whom it maintains, and who would be temporarily injured by a readjustment. Protection is led by those who are interested in terms of millions, free trade mostly by those who are interested relatively in terms of pennies. The contest is so unequal that it is only wonderful that any circumstances have ever given the latter even a temporary victory.

In Europe till the 17th century, and in most parts of that till the 18th, the only way the bounds of free trade were extended was by conquest; and even that did not always effect it, old provinces and feudalities retaining their rights to separate custom-houses — primarily an octroi, but used for "protection." Most countries were cut up by dozens of these vexatious boundary lines, crippling all internal trade, and making each little district a special and self-subsistent world. Under Louis XIV Colbert (1665–83) swept away many of these old provincial barriers, to the enormous development of French industry and trade, and consequently revenue; but he could not touch the chief portion. Already in 1623 De la Croix had propounded the theory of free trade; and in England it was urged in 1696 by Nicholas Barbon, one of the founders of the life-insurance system. But about the middle of the 18th century it sprung into life at once in two quarters, the lesser influence at the time having been vastly more potent in the end: with the French "Physiocrats" and Adam Smith. The theory of the former — whose founder was Cantillon and the chief heads Quesnay and De Gournay — was enthusiastically taken up by a group of able thinkers and men of affairs, and in 1774 put partially in practice by Turgot, in free trade for grain throughout France. Their method of approach was curious: they held that as commerce does nothing but transfer from hand to hand wealth already existing, without creating new, the gains of the trading class are at the expense of the only real wealth, the products of the earth; it is therefore to the community's interest that they should be as small as possible, and to this end commerce should take the shortest and most natural channels, as this leaves the "net product" of society the highest. Meantime in 1752–63, Adam Smith, a professor of moral philosophy at the University of Glasgow, had been working out a theory of the social progress of nations; and, as one branch of it, he investigated the causes of their material well-being. He was anything but a man of business, but he had a Scotch intellect which reasoned truly, and his society included many keen and able merchants and importers of the day. From them and his own mind he produced and fortified the theory that dams in a stream could never create water, but only force it into other channels. He visited France and met the Physiocrat leaders, and received doubtless new arguments and fresh facts. In 1775 he published his 'Wealth of Nations,' perhaps the most epoch-making single book of all time; for it created political economy as a science and free trade as a practical system. He took separately each kind of protective duty in use or advocated, and proved that each did harm in the very line it was supposed to do good. But he saw no hope of free trade ever coming about in England, so dominating was the influence of invested capital and of "furious and disappointed monopolists." But a curious change in industrial affairs inverted the position of his friends and enemies. His views had been favored by the landed interest and disfavored by the manufacturers; but the course of business made the agriculturists eager to keep up the duties on grain, which gave them immense profits; while the manufacturers began to be irked by the duties on raw material, which checked their coming dominance of the textile market under the splendid English inventions. The ablest statesmen were on the same side: Shelburne and the younger Pitt were convinced free-traders, and the latter tried to put Irish free trade into the act of Union in 1800. Two decades later the adherents were numerous: Ricardo's 'Political Economy' had reinforced Smith's, with greater weight because he was a successful Jewish banker; and London merchants were petitioning to have the shackles taken off trade. The first great success was making William Huskisson president of the board of trade in 1823; he was ignominiously driven from the Cabinet by the Duke of Wellington, but had induced Parliament to free some articles and lighten the duty on others. Thrust aside by more pressing politics, the reform stood still till 1836, when a failure of crops made it once more a burning question. Never was an issue so sharply marked out: the people were sacking the towns for bread while grain was taxed to enrich the landlords. Meantime manufacturers, increasingly the chief reliance of the national revenues, were kept out of foreign markets by having to pay higher for raw materials and more for wages. Local Anti-Corn-Law Associations from 1837 on were fused into the National Anti-Corn League in 1839; at its head were Richard Cobden and John Bright, both partners in Manchester calico-printing works; whence the term "Manchester School" for supposed believers in various doctrines mistakenly attributed to Cobden. The struggle convulsed

England, and almost broke the bonds of social order; but the final blow to the old system was the Irish potato famine in 1845. This shortage made food still higher; and Sir Robert Peel, who had taken office expressly to resist the repeal of the Corn Laws, remained in it to repeal them himself, 26 June 1846 — most of the duty at once, the rest by a sliding scale within three years.

The full free-trade policy was not introduced for many years, however: it was Mr. Gladstone in 1869 who framed the present system of absolute freedom from protection, though as Palmerston's chancellor of the exchequer in 1861 he had taken a long step toward it. In 1841 more than 1,000 articles were on the customs list, over half of them large staples; in 1849 they were reduced to 515, and in 1855 to 414, but still 153 main articles of consumption; while in 1861 they were reduced at a blow to 142, of which only 19 were of great importance, and in 1876 to 42, of which 10 were important. They have since been reduced to 12 altogether, in as few classes as possible — seven kinds of drinks, three of sweets, one narcotic and one food; namely, spirits, wine and beer; tea, coffee, chicory, and cocoa; sugar, molasses, and glucose; tobacco; and dried fruits.

It may be said here that in the last 30 years of protection, the total increase of British imports and exports was $340,000,000; in the first 30 of free trade it was $2,400,000,000, between seven and eight times as much. In 1816-40 the total increase in British shipping was 80,000 tons; from 1848 to 1858 it was 1,257,000, and thence to 1880 1,917,000 more. The experience of Belgium was even more striking. Under Napoleon prohibitory duties were imposed, and the country became largely depopulated; with the return of the Dutch and low duties, great manufactures at once sprang up; with their expulsion in 1830 high protective duties were again imposed, and in 1851 the prime minister declared that if they were not removed all domestic industry would be ruined; the whole system was swept away in 1855, and Belgium rapidly became, size for size, the foremost industrial and commercial state of the world, the richest per capita, and the manufactory of Europe. Only a few per cent of its revenue is from imports, the rest being from internal duties.

The arguments for free trade cannot be stated without those against protection, being the same. They are not alone industrial, but political and social. Broadly, it is asserted that protection cannot increase the total industrial product to be divided up, and can only enable one class of the community to force the remainder to buy one costly article instead of two cheap ones, thus lessening the volume of trade and production; that its claim, to redistribute the amount in wages is false, as but for the system the same capital would have been employed in other industries and paid as much wages, with lower prices to the consumers; that its claim to ultimately reduce prices is false, because as soon as that object has been achieved, it applies to the government on that very ground to save it from ruin by increasing the duty; that its claim to found industries is false by demonstration; and that it narrows instead of diversifying them; that it extorts high prices from home consumers by squeezing the market of which it is given a monopoly, and then sells its surplus to foreigners at a low price — which Adam Smith sets down as inevitable with a protective system; that it produces trusts, to prevent competition through which the public might secure its alleged benefits; that it produces alternate "feast or famine," inflation and panic, instead of equable business; that it makes orderly public finance impossible, by creating huge random revenues to be spent at random, in place of a calculable budget; that it corrupts politics deeply and hopelessly, by making masses of capital dependent on legislation for its profit, and consequently influencing that legislation for its own ends, stripping the treasury to prevent repeal of duties, inventing extravagant schemes to spend an unnecessary revenue, and buying votes in its favor by enormous permanent burdens on the people, through pensions, etc., is mainly due to this money power created by legislation. For the opposite side, see PROTECTION. See also ECONOMICS; TARIFF.

Bibliography.— Smith, Adam, 'The Wealth of Nations' (1776); Ricardo, 'Works' (McCulloch 1846); Prentice, 'History of the Anti-Corn Law League' (2 vols., 1853); Mongredien, 'History of the Free Trade Movement in England' (1881); Allen, 'The Tariff and its Evils' (New York 1888); Bastable, 'The Theory of International Trade' (London 1897); Smart, 'The Return to Protection' (ib. 1904); Fisk, 'International Commercial Policies' (New York 1907); Pierce, 'The Tariff and the Trusts' (ib. 1907); Robertson, 'Trade and Tariffs' (London 1908); Curtiss, 'The Industrial Development of Nations and a History of the Tariff Policies of the United States and Great Britain' (3 vols., Binghamton, N. Y., 1912); Higginson, 'Tariffs at Work' (London 1913); Matthews, 'Taxation and the Distribution of Wealth' (New York 1914).

FREE WILL. This question is properly divided into two sections, that of the metaphysical basis and the doctrinal application; but the latter has so deeply affected the reasonings on the former, that it is almost impossible to separate them.

The metaphysical problem is unique, from its presenting at the outset an irreconcilable contradiction between the phenomena of consciousness and the operations of reason. In this respect it is different from the insoluble problems of time and space, where the conflict is between opposing conclusions of the reason with regard to the materials furnished by consciousness; here there is a denial, by reason, of the validity of those materials. Consciousness appears to show us at every moment that we can dictate our actions mostly and our thoughts very largely; reason tells us that each follows on other phenomena, from whose invariable relation of precedence we characterize them as cause and the former as effect. Consciousness tells us that our will is the active agent in producing the phenomena which immediately succeed it; reason tells us that this fancied agency is an illusion and itself a part of the chain of sequences, and that the apparent relation is because, as Hobbes says, the so-called will is the last wish of the mind before determining. But what causes the determination? This involves the problem of the nature of the will as before, as well as of the "coupling-pin" by which, if a reality, it acts on matter; if not a reality, the reason why a mental resolve is invariably followed by a physical movement or mental conception. Of the coupling-pin no acceptable theory has ever been framed; the best explanation of the association of will and act, supposing the former an illusion, is still Spinoza's, that they are twin phases of the same ultimate reality, and of necessity change coincidently. But this leaves it still unexplained why our consciousness makes the will not coincident with the act, but invariably its predecessor: we do not will and act simultaneously, but in succession. The overwhelming weight of reason, however, for 2,500 years, from the Greek predecessors of Aristotle to Jonathan Edwards, has won reluctant acceptance to the doctrine of universal determinism, or in theological phrase, of necessitarianism: a chain of causation extending to all things and back to infinity, since no uncaused first act or idea can be fancied except as part of the First Cause of the universe. It is of course never claimed that all acts are volitional or all volitions deliberate, but only that the mind at will can interject uncaused determinations among the caused. It is evident, however, that to assume the possibility of uncaused acts is to consign the universe to chaos and abolish the reign of law; that only on the theory of strict and unbroken causation (or "invariable sequence") can we reason at all concerning phenomena; that the mind must follow the same law as other entities, and has no power, nor could even be endowed with such by omnipotence, of willing without motive — that is, without a cause itself the resultant of an endless series of other causes. Indeed, as Professor Huxley puts it, for the mind to cause itself implies that it has anteceded itself, which is absurd; the first mental action must have been part of the chain of causation, which surrenders the whole case, as there is no spot where it can be imagined that it was able to throw down the ladder by which it had climbed, and cut loose from causes into a region of caprice.

To avoid this conclusion, a curious dilemma — usually known as "Buridan's Ass," though Buridan did not devise it — was invented by the mediæval schoolmen. Suppose an ass between two bundles of hay, exactly alike, and with no motive for choosing which to bite first: it is absurd to suppose he would starve in the midst of food, and he must therefore act from free will. To this, however, it was answered that if motiveless he would so starve; and the question remained as before.

Involved with this is the question of God's foreknowledge. It is obvious that this involves his pre-determination of events, as otherwise he would foreknow what was never to happen, or was to happen outside his will; and there can be no change in the predestined order, since any change in a sequence must itself be part of the predestination and foreknowledge.

Alone of all metaphysical questions not incident to the claims of religious founders, this has always been a fierce battle-ground, the dividing line of great religious sects. The reason is that the possibility of sanctions for moral law, and consequently of a decent basis for human society, is believed to depend upon it. Determinism seems to cut the roots of moral obligation, by removing the possibility of obedience to it. If we are without will except as a consciousness of preference resulting from causes outside our control, we are automata; and preaching obligation of any sort to us seems as irrational as preaching it to a doll, for our action will not be influenced by it, nor are we responsible for disobedience. In this extreme form, the fallacy is easily apparent. The will, as Edwards has put it, always follows the greatest seeming good: but its estimate of good is not an unvarying thing, but constantly changing with experience and reason. Now moral rules, apprehended and accepted by the mind, form a part of this good, and therefore become new causes which determine the will: and whatever may have been the causation which has determined the evolving and enforcing of the moral law, it is nevertheless a portion of the environment which acts on the mind. As to responsibility, the question is irrelevant. An automaton which runs into a fire or the sea perishes none the less than if the act were a conscious volition. Punishment waits not on responsibility, but on violation of the laws of its being, and blame and excuse are alike impertinent to the result. We do not blame a child who burns its fingers, but the fingers are in the same condition as if we did.

Back of this, however, lies a contradiction of fact. So far from determinism making moral law impossible, free will makes it impossible. If volition can perpetually nullify the action of motive, there is a fatal breach in the continuity of cause and effect; there can be no calculable sequence of action and therefore no law. The most perverse defiance of natural order is no more independent of cause than the steadiest obedience, for that perversity is itself due to causes precedent. Whence then come the invariable consciousness of freedom to act, its universal recognition, its embodiment into the framework of society, the obvious fact that there can be no society except on this basis? Why, here again, do consciousness and practice oppose themselves unalterably to invincible argument? Edwards explains that though we have not liberty of willing, we have liberty of action; which taken literally would imply that the will has no necessary connection with the act, and that we may voluntarily do a thing we have involuntarily willed not to do. Of course Edwards does not in fact maintain this, but only that God has given a choice of action by furnishing experience and reason and illumination by which to frame correct determinations. Waiving discussion of the difference between these determinations and will, the real explanation probably lies in the confusion between the abstract and concrete will, between its dependence on causes and, as above said, our own power to determine or change those causes. Instruction, example, appeals to self-interest or fear, or vanity, or affection, or honor, etc., produce an environment and modify the view taken by each of the supreme immediate good, calculably enough to base coherent society upon; where their effect is grossly miscalculated the society goes to pieces. Metaphysics and the general consciousness are both right, each in its own sphere: the will must have motives, but those motives are furnished in great measure externally. Furthermore, subject to the inexorable limitation, it can furnish by its own action motives to change itself; and constantly does so, attributing to its independent action what is really due to the influence of the new causes it has made to operate in altering its estimate of relative good. For the purposes of human life, volition is absolute and there is no injustice in enforcing responsibility.

Consult Edwards, Jonathan, 'Freedom of the Will' (London 1754); Bennett, W., 'The Religion of Freewill' (Oxford 1913); James, W., 'The Will to Believe' (New York 1897); and 'Principles of Psychology' (New York 1899); Levy, P. E., 'The Rational Education of the Mind' (Boston 1914); Martineau, J., 'A Study of Religion' (2 vols., Oxford, 1888); Mill, J. S., 'Logic' (London 1856); Rashdall, H., 'Theories of Good and Evil' (Oxford 1907); Stewart, D., 'Moral Philosophy' (Edinburgh 1854); Ward, J., 'The Realm of Ends' (Cambridge 1911).

FREEDEN, frā'dĕn, **Wilhelm Ihno Adolf,** German mathematician and navigation expert: b. Norden, Hanover, 1822; d. 1894. He received his education at the universities of Bonn and Göttingen. For a number of years he was head of the school of navigation at Elsfleth, and in 1867 founded the German Naval Observatory at Hamburg, of which he was in charge until 1875. This observatory was designed to facilitate maritime intercourse, and consists of the departments of marine meteorology, of coast meteorology, of signal service, chronometer testing and bureaus of nautical, meteorological and magnetic instruments. He was in the Reichstag in 1871–76 and until 1891 was editor of the *Hansa, Zeitschrift für Seewesen,* which he had founded together with H. Tecklenborg-Bremen.

FREEDMAN. See FREEMAN.

FREEDMEN'S BUREAU, 1865–69. The supervision, temporary maintenance and employment of the mass of homeless, penniless and untaught freedmen created by emancipation was an obvious duty of the government, urged upon it at once after the proclamation of 1 Jan. 1863; and in 1863–64 officials were appointed to lease abandoned lands to them for terms not exceeding a year. The military officers left much of the care and provision for freedmen in their hands; but a more comprehensive plan was needed, and after various abortive efforts at an acceptable measure, a «Bureau of Refugees, Freedmen and Abandoned Lands» was established in the War Department, 3 March 1865, to continue for a year after the war. It was to be headed by a commissioner, with assistant commissioners in all the seceded States; to issue supplies to destitute freedmen, have charge of abandoned lands to lease and ultimately sell in 40-acre plots, and have «control of all subjects relating to refugees and freedmen» — an elastic provision construed in the most elastic way. Its commissioners — the head being Gen. O. O. Howard (q.v.), a noble-minded and laborious philanthropist — acted as courts of law where there were none, or where negroes were not recognized as free; established the institution of marriage, and kept records; assured the freedmen the right to choose employers, and made fair contracts for them. The «abandoned lands» disappeared under the amnesty acts; but the bureau did excellent work by inaugurating free schools on a large scale. On 6 Feb. 1866 Congress passed a bill to enlarge its powers and make it permanent; Johnson successfully vetoed it, but on 16 July another was passed over his veto, extending the bureau to July 1868, later extended a year in unreconstructed States. Under this its sweeping powers made it largely the government of the South under Reconstruction, especially as the department military commanders were usually made assistant commissioners; and the demoralizing and disastrous struggle of the North to secure negro independence and of the South to reassert white mastery, is a history of part of the bureau's action — through executive and legislative powers scarcely pretended to be constitutional, and to transfer which to the regular courts the Fifteenth Amendment was passed. The bureau was regarded with detestation in the South; a large number of its officers secured office through negro support; and its influence was exercised in organizing the blacks politically against the whites. Better features of its work were the foundation of the free public schools in the South, and of Fisk, Howard and Atlantic universities, and Hampton Institute; of the system of negro peasant proprietorship; and the winning of equal rights for all men in the courts. That it failed in its larger hopes, and that its harmful results were so great that many hold them far in excess of its benefits, are facts attributed by the fairest judges to the inevitable conditions of the problem. (See a very lucid and singularly just summary by W. E. B. DuBois — colored — in the *Atlantic Monthly,* Vol. LXXXVII, p. 354). The bureau ended its main work in 1869; its educational work continued till 1872, and bounty payments some years longer. It had about 900 agents in 1868; and expended in all some $20,000,000, over $10,000,000 on objects unconnected with soldiers' bounties. General Howard published a report of its work in the House Executive Documents, 41st Congress, 2d session. Consult Pierce, 'The Freedmen's Bureau' (Iowa City 1904).

FREEDMEN'S SAVINGS AND TRUST CO., usually called **FREEDMAN'S BANK,** a savings bank chartered by Congress in the District of Columbia by an act approved 3 March 1865, at the special instance of Charles Sumner and Charles R. Buckalew, as a means of encouraging thrift among the newly emanicipated negroes. It was in fact intended as part of the Freedmen's Bureau work, and had among its corporators General Howard, the chief commissioner, and a host of the most eminent and upright public men and philanthropists; and its investments were restricted to government securities. It started branches in some 30 Southern cities, with doubtful legality, but covered by the elastic ægis of the bureau's power and everyone's good will, the South's most of all; and did a large business. But the corporators appointed successors much less disinterested; the restriction on investments was removed in 1870, ostensibly to benefit depositors by a higher rate of interest, against the protest of Simon Cameron in the Senate; the securities were rapidly replaced by «wildcat» stocks, all speculative and mostly worthless, and by mortgages on valueless property; and in 1874 the bank was pronounced insolvent, with practically no assets. At that time there were 61,131 depositors with a total of $2,939,925 deposits. As a result of bankruptcy proceedings about 62 per cent or $1,822,753 of this indebtedness has been paid off. The blow to incipient negro thrift was very great; and the scandal discredited the entire system of which the bank was an outcome, and was one cause of the political overturn in 1874. Consult Anon., 'The Story of the Freedman's Bank' (in *Nation*, Vol. XX, p. 253, New York 1875); United States; Banking and Currency Committee, 'Freedman's Savings and Trust Co.' (Washington 1910); United States, 'Acts and Resolutions' (38th Congress, 2d Session, Washington 1865).

FREEDOM, Pa., borough in Beaver County, 25 miles northwest of Pittsburgh, on the Pittsburgh, Fort Wayne and Chicago Railroad, and on the Ohio River. There are manufactures of caskets, monuments and oil. Pop. 3,060.

FREEDOM, Personal, the liberty of the individual to determine the course of his own actions, subject only to restrictions the same for all and as few and liberal as the public safety permits. It is characteristic of a social condition where the individual is the fundamental unit, rather than subordinate communities such as the family or the clan. Accordingly, the gradual eclipse of the family by the individual characteristic of European social history has led to the removal of such obstructions to personal liberty as the Roman right of the father. The disappearance of slavery and of serfdom is likewise a natural consequence of the supersession in their rôle of political units of the household and the estate by the individual. In the modern democratic state, personal liberty exists as a recognition of the right of each individual, within limits, to do what he pleases without the constraint of his fellows to go where he pleases, to work at whatever trade he pleases and to own whatever property he can purchase. All these rights are strictly limited in the case of minors, and even among adults, the welfare of the State has necessitated such restrictions as punishments, quarantines, special professional qualifications and taxes. In times of emergency the right of the State to dispose of even the lives of its constituent individuals for the common good is universally recognized. That the restriction on the individual by the State shall not be more oppressive than necessity demands is secured by various clauses in the constitutions of the several nations of the world. In English-speaking countries, one of the most trusted weapons against the abuse of the powers of the State is a constitutional provision concerning writs of *habeas corpus* (q.v.).

FREEDOM OF CITY. The custom of granting to a distinguished visitor the "privileges connected with municipal citizenship," which is known as conferring "the freedom of the city" obtains in both American and European cities. The practice is to enter the names of such "honorary citizens" upon the register of municipal electors, but they are not actually entitled to exercise the franchise or to become members of the city's governing bodies. The custom amounts nowadays to little more than a public expression of esteem, but its history goes back to the mediæval days when it was a notable and valuable gift. When the custom originated there was no general recognition of the right of freedom of domicile, and cities were more like private corporations with restricted membership than our modern cities. Such membership — municipal citizenship — was usually obtained only after a long period of apprenticeship to one of the recognized guilds, followed by examination, and enrolment as a "master workman." In such circumstances, the immediate and unencumbered gift of "the freedom of the city" by the vote of the magistrates was a considerable favor, and it was only granted to persons whose wealth or renown made their citizenship substantially desirable to the other burghers.

FREEDOM OF THE SEAS. See INTERNATIONAL LAW.

FREEDOM OF SPEECH AND OF THE PRESS. By this is understood the essential right embodied in liberty of speaking and publishing the truth with good motives and for justifiable ends, in regard to the actions of the government, of officials, or individuals. The different bills of rights in State constitutions contain provisions along the same lines as those contained in the First Amendment of the Federal Constitution that no law shall be made "abridging the freedom of speech or of the press." This preserves an important feature of personal liberty long recognized in the constitution of England and maintained in the United States where in fact liberty in speaking and publishing one's opinions is subject to even fewer restrictions than in England. These constitutional provisions, however, do not imply that liberty of speech and publication shall be free from responsibility and not subject to regulation. Improper speech and publication can incur both civil and criminal liability as determined by general law in the protection of property, person and reputation. These regulations and restrictions comprise: (1) Civil liability to damages for injuries caused by slander, that is, the speaking of false and malicious words concerning another resulting in injury to his business or reputation; (2) both civil and criminal liability for libel, which is the publication by writing or printing of matter calculated to injure the business of another or his character by bringing him into ridicule, hatred or contempt, under circumstances rendering such publication unjustifiable and without lawful excuse; (3) criminal punishment for the speaking or publishing of blasphemous, obscene, indecent or scandalous matter. Damages may be recovered in a civil suit for libelous statements made maliciously or without proper occasion to the injury of another. The truth of the statements may be pleaded as justification for a complete defense; but unless their truth is established, defamatory words spoken or written are presumed to be false, and they are also presumed to be malicious unless the occasion of their being spoken or published is such as to render them privileged.

FREEDOM OF THE WILL, a work by Jonathan Edwards. It is an amazing fact that this treatise, undoubtedly the greatest contribution of America to metaphysical thought, was written within a period of four months, while the author was a missionary to the Indians in a frontier settlement. But the work is amazing for other reasons also. Its power of close argumentation was reckoned by so able a critic as Sir James Mackintosh as «perhaps unmatched, certainly unsurpassed.» The reputation of its awful audacity still haunts the minds of men who know no metaphysics and recite no creeds. Properly to understand the book, however, it is necessary to go back to Edwards' youth, and to read his romantic outpourings on the beauty of holiness, the serene delights of the gardens of faith, and the fragrance of the love of God. These things still underlie the terrible logic of the later treatise, though concealed from superficial gaze by the unfortunate results of his reforming zeal and by his long-developed habit of controversy. To Edwards the Arminian theology of the day — which held that man is free to choose between good and evil and owes his salvation to his own choice as well as to the grace of God — was a manner of trifling with the tremendous issues of sin and of slighting the supreme prerogative of Deity. It is to make a mockery of sin, he argued, to suppose that men would deliberately and knowingly choose evil and pain in place of good and happiness; man's freedom is confined to his ability to carry out his inclinations, but his so-called will is nothing more than his inevitable inclination toward that which at the moment of action seems to him best. In the same way it is to derogate from God's majesty to look for any cause in the world outside of His omnipotent will. Hence the inclinations of men, as they must have a cause, are traced back to their source in God, whom Edwards does not hesitate to call «the author of sin,» though, as he insists, «for wise, holy and most excellent ends.» It is of course a manifest injustice to reduce Edwards' vast argument, a veritable megalotherium of metaphysics, to so puny a compass. More than that, any prospective reader should be warned that the spirit and intention of Edwards cannot be judged from this treatise alone, but must be gathered from the whole range of his works.

Paul Elmer More.

FREEHAND PERSPECTIVE. See Art Drawing.

FREEHOLD, N. J., town, county-seat of Monmouth County, on the Central Railroad of New Jersey, and the Pennsylvania Railroad; about 32 miles southwest of Jersey City. It was settled in 1734, and for some time it was called Monmouth Court House, because the county court was held in the village. In 1869 it was incorporated, and the commission form of government has been adopted. It is the trade centre for a large agricultural section. Its chief manufactures are bicycles, foundry and machine-shop products, underwear and shirts. There is also a large canning factory. One of the attractions of the town is the granite monument in memory of the battle of Monmouth (q.v.) which took place here 28 June 1778. Pop. 3,622.

FREEHOLD, in English and American law, an estate or real property held in fee simple in America, or in England either in fee simple or fee tail; the tenure by which such an estate is held. (See Fee.) Anciently it was one of the two chief tenures known as tenure in free socage, and was the only free method for laymen to hold property. A freehold estate must possess immobility, in other words, must consist either of land or of some interest arising out of land annexed to it. Secondly, it must be of indeterminate duration. Consult Digby, K. E., 'An Introduction to the History of the Law of Real Property' (Oxford 1875); Pollock, Sir F., and Maitland, F. W., 'History of English Law Before the Time of Edward I' (2 vols., Cambridge 1895).

FREELAND, Pa., borough in Luzerne County, on the Lehigh Valley and Central Railroad of New Jersey, about 30 miles southwest of Scranton. It is situated in the anthracite coal region, but is surrounded by a large section of good farming land. The chief industrial establishments are two silk mills, an overall factory, two coal mining companies, etc. There are two banks with aggregate resources of about $1,150,000. The value of taxable property (1916) was given as $2,028,273. Educational institutions are the Mining and Mechanical Institute, public and parochial schools. Receipts of government (council of 12 members) $21,629 and expenses $20,465, as reported in 1916. Pop. 8,000.

FREEMAN, Alice Elvira. See Palmer, Alice Freeman.

FREEMAN, Edward Augustus, English historian: b. Harborne, near Birmingham, 1823; d. Alicante, Spain, 16 March 1892. He was educated at Trinity College, Oxford, where he obtained a scholarship in 1841, and after his marriage in 1847 he retired to a small estate at Somerleaze, in Somerset, where he devoted himself to literature. His first publication (1849) was a 'History of Architecture,' a subject in which he maintained interest throughout his life. This work was more especially devoted to Gothic architecture. His architectural researches helped to turn his attention to history, but his earliest historical works were the product of his interest in contemporary burning questions. His 'History and Conquests of the Saracens' (1856) was partly due to the Crimean War; and the American Civil War brought forth his 'History of Federal Government' (1863), which, however, remained a fragment in one volume. Between 1867 and 1879 appeared his *magnum opus*, the 'History of the Norman Conquest of England,' in six volumes, followed in 1882 by two supplementary volumes dealing with 'The Reign of William Rufus and the Accession of Henry I.' In 1884 he was appointed regius professor of modern history at Oxford, and this post he occupied till his death. His last great work was a 'History of Sicily,' which he left unfinished, though three volumes of the work were published. He died in Spain, where he was traveling for the purposes of recreation and research. Other works of his beside those mentioned were 'Essay on Window Tracery'; 'The Architecture of Landaff Cathedral'; 'History of Wells Cathedral' (1870); 'Old English History for Children' (1869); 'Growth of the English Constitution' (1872); 'Historical Essays' (three series, 1871–79); 'The Ottoman Power in Europe' (1877); 'Historical Geography of Europe' (1881); 'Subject and Neighbor Lands of Venice' (1881); 'Lectures to American Audiences' (1882); 'English Towns and Districts' (1883); 'Some Impressions of the United States' (1883); 'Exeter'

(1887); ‘Methods of Historical Study’ (1886); ‘The Chief Periods of European History’ (1887); ‘William the Conqueror’ (1888); ‘Studies of Travel’ (edited by Miss F. Freeman, 3 vols., 1893, 1897). He was a man of strong partisan feeling, which sometimes interfered with a judicial weighing of evidence. But he took great pains to verify his facts, indeed was devoted to truth, and had a wide and deep knowledge of history. The charge of prolixity made against him is not without foundation, but when in the mood he displayed remarkable powers of compression. He had a marked preference for the use of words of purely English origin. In spite of his pugnacity and the obstinacy with which he maintained his side in a controversy he was a man of generous and kindly nature. Consult ‘Life and Letters,’ by Stephens (1895).

FREEMAN, James, American Unitarian clergyman, the first in the United States to assume the name Unitarian: b. Charlestown, Mass., 22 April 1759; d. Newton, Mass., 14 Nov. 1835. He was graduated at Harvard College in 1777, in 1782 became lay-reader in King's Chapel, Boston, later proclaimed himself a Unitarian, and, supported by his congregation, secured corresponding changes in the prayer-book. In 1787, his bishop having refused him ordination, he was ordained by his wardens and congregation. Until his death he was sole minister of the chapel. He received the degree of D.D. from Harvard in 1811; he was a liberal and accomplished scholar. He published ‘Sermons and Charges’ (1832).

FREEMAN, James Midwinter, American Methodist clergyman: b. New York, 29 Jan. 1827; d. Morristown, N. J., 27 Feb. 1900. He was educated at Wesleyan University, ordained in the Methodist Episcopal Church in 1850 and held pastorates of various prominent New Jersey churches for 22 years. From 1872 until his death he was assistant editor and corresponding secretary of the Sunday School Union and of the Tract Society of the Methodist Episcopal Church. He also acted as secretary of the board of trustees of the Centenary Collegiate Institute and of that of Drew Theological Seminary, as well as secretary of the Methodist Historical Society of New York City.

FREEMAN, Mary Eleanor Wilkins, American novelist: b. Randolph, Mass., 1862. She was educated at Mount Holyoke Seminary and after some years spent in Brattleboro, Vt., returned in 1883 to Randolph, which remained her home till her marriage to Charles Freeman in January 1902, when she removed to his home in Metuchen, N. J. She came first into notice about 1886 by her extremely faithful delineations of certain phases of New England life in her short stories contributed to the magazines; then attempted more sustained work, and published several novels, displaying the same characteristics. Her work steadily gained in popularity and has been admired by English as well as American critics. A fondness for very short sentences gives it almost a staccato character at times, and while the accuracy of her studies of New England village existence cannot be called into question, her insistence upon the bareness of the life to the exclusion, or almost entire subordination of its happier phases, conveys a not wholly correct impression of the life in its entirety. Her published works include ‘The Adventures of Ann’ (1886); ‘A Humble Romance and Other Stories’ (1887); ‘A New England Nun, and Other Stories’ (1891); ‘Young Lucretia’ (1892); ‘Giles Corey, Yeoman,’ a drama (1893); ‘Jane Field,’ her first novel (1893); ‘Pembroke’ (1894); ‘The Long Arm,’ with J. E. Chamberlin (1895); ‘Jerome, a Poor Man’; ‘Silence and Other Stories’; ‘The People of Our Neighborhood’; ‘Understudies’; ‘Madelon’; ‘The Love of Parson Lord’; ‘Evelina's Garden’; ‘The Wind in the Rose-Bush’; ‘The Givers’ (1904); ‘Doc Gordon’ (1906); ‘By the Light of the Soul’ (1907); ‘Shoulders of Atlas’ (1908); ‘Winning Lady’ (1909); ‘Green Door’ (1910); ‘Butterfly House’ and ‘Yates Pride’ (1912); ‘Copy Cat and Other Stories’ (1914); ‘The Jamesons, and People of Our Neighborhood’ (serially, 1914).

FREEMAN, Nathaniel, American jurist: b. Dennis, Mass., 8 April 1741; d. Sandwich, Mass., 20 Sept. 1827. After studying law and medicine he moved to Sandwich in 1763. He fought in the Revolution, and was brigadier-general of militia forces in 1781–91. In 1795–99 he was a member of the United States Congress, sat in the Massachusetts legislature, and was for many years judge of probate and of the court of common pleas. He was also a medical practitioner, and an orator of some distinction.

FREEMAN, or FREEDMAN, is one who has inherited the full privileges and immunities of citizenship; one who has been delivered from the restraints of bondage, but who, usually, is not placed in a position of full social or even political equality with him who was born free. In old Rome, the equivalent for freeman comprehended all classes of those who were not slaves. As the organization of Roman society survived the convulsions of the Middle Ages to a far greater extent in the towns than in the landward districts, where the institutions of feudalism (q.v.) almost entirely superseded it, it is in the borough and other municipal corporations of Europe that we still find freemen, or persons inheriting or acquiring by adoption, purchase or apprenticeship the rights of citizenship. In the United States the term freemen was used of the colored people emancipated by the Civil War. The duty of caring for those people, finding them work, and preparing them for the privileges of freedom was thrown on the War Department; and in 1865 an act of Congress created in that department the bureau commonly known as the «Freedmen's Bureau» (q.v.) whose duties practically ceased in 1870. The founding of several institutions for colored persons, such as Howard University and Fisk University (q.v.), was a permanent result of its work, out of which have grown other educational achievements of great importance in the advancement of the colored people. Consult Green, ‘The Making of England’ (London, 1883).

FREEMAN'S FARM or STILLWATER, Battle of. See SARATOGA, BATTLES OF.

FREEMASONRY. See MASONIC FRATERNITY.

FREEMASONS. See MASONIC FRATERNITY.

FREEPORT, Ill., city and county-seat of Stephenson County, on the Pecatonica River, the Illinois Central, the Chicago and Northern, and the Chicago, Milwaukee and Saint Paul railroads, about 113 miles northwest of Chicago, and 55 miles southeast of Dubuque. Freeport's chief manufactures are wind-mills, automobiles, organs, gas engines, hardware, pianos, agricultural implements, drugs and chemicals, garments and toys. The United States census of manufactures for 1914 showed within the city limits 63 industrial establishments of factory grade, employing 3,013 persons; 2,566 being wage-earners receiving annually a total of $1,661,000 in wages. The capital invested aggregated $11,227,000, and the year's output was valued at $7,447,000: of this, $3,537,000 was the value added by manufacture. It has a free library, three hospitals, a good system of public and parish schools, and several fine public buildings and public parks. Freeport was settled in 1835 and received its charter in 1855. The «Freeport heresy,» a political doctrine much discussed before the Civil War, was that, regardless of the Dred Scott Case (q.v.), any territory had the right to reject the slave system by the means of police laws which would be «unfriendly,» and would in time stamp out the existence of slavery. This «doctrine» or «heresy» was advanced by Douglas in the famous debate with Lincoln which took place in Freeport in 1858. Pop. 20,000.

FREEPORT, N. Y., village of Nassau County, on Long Island, on the Long Island Railroad, 20 miles east of New York. It is mainly a residential town, contains a high school and two clubhouses. Fishing is the only local industry. It owns the electric-lighting and water plants. Pop. 7,463.

FREER, Charles Lang, American capitalist: b. Kingston, N. Y., 1856. He was educated in the public schools of Ulster County, N. Y., and for many years was engaged in railway service and manufacturing in Detroit. He is now retired. He is well known as a connoisseur in art. He presented his own art collection to the Smithsonian Institution at Washington, and donated $1,000,000 to the building fund of this institution. He received the honorary degree of A.M. from the University of Michigan.

FREESIA, a genus of plants of the iris family, including two or three species, natives of southern Africa. They have narrow, grass-like leaves and showy clusters of fragrant white or pale yellow flowers terminating the slender stems. They are popular with florists and for window gardens, and are of very easy culture.

FREETHINKER, a name assumed by those who, disbelieving in revelation, feel themselves free to adopt any opinion in religious or other matters which may result from their own independent thinking. The name was specially claimed by those who in the 17th century took part on the anti-Christian side in the deistic controversy. Voltaire (q.v.) was a well-known French freethinker.

FREETOWN, Africa, a seaport of West Africa, capital of the British colony of Sierra Leone (q.v.) on the south side of the river of Sierra Leone, in 80° 29′ N., 13° 10′ W. Its principal streets are broad and straight, and have, more especially in the part occupied by Europeans, a very attractive appearance, the houses being generally detached and surrounded by trees. Freetown is a strongly fortified imperial coaling-station. A railway runs from Freetown some distance into the interior. Its climate is very unhealthy, although in recent years sanitary conditions have been improved considerably and the death rate has gradually been reduced. A new residential suburb has been developed on one of the nearby hills (900 feet high) and has been connected with the town proper by a light railway. Freetown was made a municipality in 1893 with a mayor and 12 elected and 3 appointed councillors, being the first city in West Africa to enjoy this privilege. It is a port of call for all West African steamers and of ever-growing commercial importance. There are the usual official buildings of a small colonial capital; governor's palace, barracks, courts, schools, churches, including a cathedral, botanic gardens, etc., show the result of many years' labor. There are no horses, manual labor taking their place. In 1916 the total revenue was $48,452 and the expenditures $57,175. The net debt slightly more than $130,000. The town was founded in 1792. In September 1794 it was practically destroyed by a French squadron, but recovered in a short time. According to the census of 1911 there is a population of 34,090 of which 558 are Europeans, 169 Asiatics and 33,363 Africans of more than 15 different tribes. Consult 'The Freetown Municipality Consolidation Ordinance, 1908' (London 1908); 'Handbook of Sierra Leone' (Sierra Leone 1916); Burton, Sir R., 'Wanderings in West Africa, etc.' (Vol. I, chapter V, p. 193, London 1863); Crooks, J. J., 'A History of the Colony of Sierra Leone, West Africa' (Dublin 1903); D'Éspagnat, P., 'Jours de Guinée' (p. 277, Paris 1899); George, C., 'Rise of British West Africa, etc.' (London 1902); Sibthorpe, A. B. C., 'History of Sierra Leone' (London 1906); Sierra Leone Government, 'Blue Book' (Freetown 1917); Trevelyan, Sir G. O., 'Life and Letters of Lord Macaulay' (Vol. I, p. 29, London 1909); Villelume, Baron de, 'Au Cœur de l'Afrique' (Paris 1910).

FREEZING, CONGELATION, or SOLIDIFICATION, the transformation of a liquid into a solid under the influence of cold. Each pure liquid always solidifies at the same temperature, which is called its freezing point (q.v.), and the solid also melts again at the same temperature. Thus the freezing point and the melting point, or point of fusion, are the same, and the point is always the same for the same substance. The freezing point of water, or the melting point of ice (32° F.), is taken for one of the fixed points in thermometry. The freezing point of mercury is 39° below zero, of sulphuric ether 46° below zero, of alcohol 203° below zero F. It has been shown that the increase of pressure on water, and on all substances which expand in freezing, will lower the freezing point; and that such substances as wax, spermaceti, sulphur and paraffin, which contract in freezing, have the freezing point raised by pressure. See MELTING-POINT.

FREEZING-MIXTURE, a mixture for the production of artificial cold by absorption of heat. For this purpose two substances are mixed, of which one is usually solid, and which tend to form a liquid mixture. In liquefying any solid a certain amount of heat is made latent, and owing to this the temperature of the mixture at the end of the liquefaction is often very low. Thus on mixing snow and salt together the salt converts the snow into water, or rather tends to form brine; but snow cannot melt without withdrawing from something a quantity of heat. It may withdraw this heat from the salt, or partly from surroundings. Hence the temperature of the brine which is the result of the mixture is very much below that of either the salt or snow. The fact is that salt and water mixed cannot be in the solid condition, except at a temperature very much below that of ordinary snow. The table gives a list of freezing-mixtures, and of the lowering temperature obtained by means of them. See ICE, ARTIFICIAL; REFRIGERATION AND REFRIGERATING MACHINES.

Substances and parts by weight	Reduction of temperature, F.		Total temperature reduction, F.
	From	To	
Snow 2, sodium chloride 1	+32	—5	37
" 2, calcium chloride 2½	+32	—40	72
" 2, calcium chloride crystals 3	+32	—50	82
" 12, sodium chloride 5, ammonium nitrate 4	+32	—25	57
" 3, dilute sulphuric acid 2	+32	—23	55
" 3, hydrochloric acid 5	+32	—27	59
" 3, potassium 4	+32	—51	83
Sodium nitrate 3, dilute nitric acid 2	+50	—3	53
" phosphate 9, dilute nitric acid 4	+50	—12	62
" sulphate 6, ammonium nitrate 5, dilute nitric acid 3	+50	—40	90

FREEZING POINT, the degree of cold at which a liquid freezes. It may be stated as accurately as the degree of heat at which a liquid congeals, since everything above absolute zero represents some degree of heat. In the case of water the freezing point is 32° F. or 0° C. The fusing or melting point of a metal is also its freezing point, the point where it changes from the liquid to the solid condition if the temperature is going down, or from solid to liquid if it is going up. But as the melting points of metals are regarded as hot, we use the word fuse, except in the case of mercury or quicksilver. The freezing or fusing points of familiar substances are:

Hydrogen	—328° F.	Sulphur	235° F.
Mercury	—38	Tin	551
Bromine	—20	Bismuth	517
Water	0	Zinc	811
Olive oil	50	Lead	850
Phosphorus	112	Gold	1913
Potassium	144.5	Iron	2912
Sodium	204		

Sea water freezes at a lower point than fresh water, owing to the solution of salt and other minerals. Changes of pressure affect the freezing point as well as the boiling point. This is illustrated by the melting of glaciers from the bottom, which is the cause of their movement of flow. This melting at the bottom is due to the great weight of ice, creating pressure, which brings about melting though the temperature may be many degrees below 32° F.

To determine the molecular weights of substances, it is important to know the freezing point. To ascertain this the common method is to make a solution of the substance. The freezing point of the solution is usually lower than that of the solvent, the difference being proportional to the amounts not only of volume but of weight. The curves obtained appear to be similar to those found by tests of the boiling point to determine molecular weight. Beckman's apparatus for determining the freezing point of solutions consists of a jar containing a liquid, which can be maintained at a temperature slightly below that of the solution, and a glass tube made double, that is, with inner and outer tube, the inner tube for the solvent and the outer for air space. A thermometer scale is marked on the inner test tube. With this apparatus the freezing point of the pure solvent can be found with a close approach to accuracy. Next a definite proportion of the substance to be dissolved is added to the solvent, through a side aperture provided in the tube, and the temperature of the solution is observed. The difference between the freezing point of the solvent and the solution is then apparent. Because of different results obtained by different experimenters with different apparatus it was learned that several conditions minutely affected the final temperature recorded. The size and shape of the vessel containing the cold mixture that accomplished the freezing, and the regular or irregular stirring of the contents, and the diameter of the test tube were all found to affect the ultimate temperature, as well as the temperature of the outside of the jar, due to the temperature of the room. To check such experiment therefore a boiling test and sometimes other tests are made for molecular weight, the average result being accepted. See MELTING POINT; SOLUTIONS.

FREIBERG, frī'bĕrg, Saxony, a mining town 25 miles southwest of Dresden. It is the capital of the mining district of Saxony, and contains a mining academy founded in 1765, with 13 professors, fine scientific collections, among which is the celebrated collection of precious stones amassed by Werner, and a large library. There is a fine relic called the Golden Portal belonging to an ancient Church that stood on the site of the Gothic cathedral. It is an ancient imperial city, and is still surrounded by the old walls and ditch. The town owes its origin to the discovery of silver mines in its vicinity in the 12th century. Here, on 29 Oct. 1762, Prince Henry of Prussia defeated the allied Austrian and Saxon army. Pop. 36,237.

FREIBURG, frī-boorg, or **FREYBURG,** or **FREIBURG IM BREISGAU,** Baden, a town in the circle of the upper Rhine, in the valley of the Dreisam, and on the railway from Carlsruhe, in one of the most beautiful and fertile districts of south Germany, at the west foot of the Black Forest. It consists of the town proper, the fortifications of which have been converted into pleasure-grounds, and of two suburbs, and is the seat of a superior civil and criminal court, and of several public offices. The buildings most deserving of notice are the münster or cathedral, a large and beautiful Gothic structure built of red sandstone, admired for its delicate symmetry, with a magnificent portal richly sculptured, and surmounted by a tower, partly of exquisite open work, 380 feet high; the university, founded in 1457, the merchant house, now the chief tax office, a quaint Gothic structure, resting on pointed arches, and decorated externally with fresco portraits of the Emperor Maximilian, his son Philip I, Charles V and Ferdinand I; and the grand-ducal palace and government buildings. Freiburg is the see of an archbishop, and the seat of the courts and offices for the circle of the upper Rhine. Pop. 83,324; pop. of the entire District of Freiburg being 564,580 and area 1,830 square miles. Its university had, in the winter semester 1914–15: professors and teachers, 151; students, 2,237 (theology 250, jurisprudence 469, medicine 960, philosophy 301, and the remainder students of the faculties of mathematics and natural science). The faculty of theology in the University of Freiburg, as in the universities of Munich, Münster and Würzburg, is Roman Catholic.

FREIBURG. See Fribourg.

FREIFELD, George, American judge: b. New York city, 1856; d. 17 Nov. 1917. Of German extraction, his father served in the Civil War. Freifeld was elected a municipal court justice in 1909, and was re-elected to the second district municipal court of Brooklyn in 1917 for a term of 10 years. For over a quarter of a century Freifeld was a prominent figure in Freemasonry; he was district deputy of the third district in 1906, and in 1914–15 was grand master of the Grand Lodge of Masons in the State of New York. He served 12 years as a member of the board of education, was a life member of the Brooklyn Institute of Arts and Sciences, and vice-president of the Manufacturers' Trust Company.

FREIGHT. This term was originally synonymous with cargo, being applied to miscellaneous articles shipped for transportation by water. When the railways began to do a general transportation business in America the word freight was extended in meaning to cover all miscellaneous merchandise transported by train, other than baggage, mail and express matter paying a higher rate for quick transporation. In Great Britain, however, the word freight was not so extended in general meaning, the word «goods» being employed for miscellaneous shipments by railway, so that in England they say goods-van and goods-train with a meaning similar to freight-car and freight-train in the Western hemisphere.

The tremendous development of the United States railways, and the enormous freights they handle, have overshadowed the much smaller volume of ocean freight shipped in and out of this country, hence freight is largely considered from the railway point of view. The freedom of trade between the States, and the unprecedented development of railways has evolved a freight traffic in this country which is the marvel of modern civilization. Manufacturers no longer confine their trade to a neighborhood, but seek trade hundreds and thousands of miles away, because low freight charges enable them to compete.

Early in the history of American railways there was developed the policy of charging for freight «what the traffic would bear.» Obviously a carload of shoes, worth several hundred times as much as a carload of brick, could afford to pay a cent a pound or $20 a ton more without any danger of driving away the traffic, whereas the brick would not be shipped at all if it was assessed a rate of $20 a ton, being more than its intrinsic value. So the railroads stiffened the prices on valuable goods and took other articles at cost or less than cost, arguing that as they had to run trains both ways, they might be hauling empties if they did not accept cheap «fillers.» They were further urged on by the continual threat of competition by canal, river or coast vessels. The railway interests thought it good policy to keep these out of existence, because water transportation is cheaper than railway, although slower. So they underbid for freight on stone, brick, lumber, coal, grain, etc., to hold the trade and keep down canal and river competition, believing that if these got a good start they would make a bid for the higher class freight that could pay a profitable price. Under such conditions the railways of America have built up a freight traffic that far excels the passenger and express traffic. There are more than 40 times as many freight cars in use on American railways as there are passenger, mail and express cars combined.

Freight rates, originally based on market conditions, next had to meet competitive conditions, to points where other railways led, or where there was water communication. For many years the railways competed for freight, and cut-rate wars between the roads were common in the last century. Then it developed that very large shippers who could dictate to railways demanded and secured rebates, thus getting an advantage over small competitors; also that certain cities had been discriminated against, and that the railways actually carried freight to some centres, say 500 miles for less than they charged intervening cities at a distance of 300 or 400 miles. Under such conditions freight rates had become so much mixed and complicated as to be unintelligible to the mass of people, seemingly senseless, and often grossly unfair to those who considered the charges from the basis of equity. Complaints were so numerous and so well founded that the Interstate Commerce Commission (q.v.) was established to secure equitable rates and rulings, and the famous regulation was established that a railway must not charge more for a short haul than for a long haul.

Conditions tended toward centralization of and consolidation of railway interests, and for years promoters and capitalists were kept busy consolidating competing lines of railway until the present great trunk lines were established, and 88 railway systems virtually control the transportation of the country, while 13 of them, each doing an annual freight business of from $50,000,000 to $150,000,000, control more than half the lines and dominate the situation. Competition has given way to consultation, and through interlocking directorates the great railway systems move largely in unison, with common interests, the protection of the shipping public lying in the dictation of the Interstate Commerce Commission.

The average haul for freight in the United States is about 140 miles, and it follows that much of the freight has to be transferred to some other railway system, and sometimes to several systems before reaching its destination. Where shipments are large, shippers hire entire cars, and the goods are loaded and go in that car to the destination, no matter how many lines it travels over. The railways charge each other for the use of such cars when detained under certain conditions. The smaller freight is subject to transfer and handling when going to other systems.

Freight Handling.— Shipments of freight may be divided into four classes: (1) Bulk articles, which subdivide into (a) free-flowing articles, as oil, grain, sand, coal, ore and broken stone, that can be run through a chute or pipe, or handled by dumping; and (b) articles requiring mechanical handling, as coke, brick, pig iron, lumber, steel beams, etc. (2) Live stock, requiring special cars, food and attendance. (3) Package freight, including boxes, barrels, crates, wrapped goods and machinery. (4) Perishable freight, as meats, vegetables, fruit, etc., much of which requires refrigeration. These classes of freight require for economical handling different methods and different cars for transportation. For handling grain, the elevator, with spout delivering right into the cars or vessel, has been highly developed. For oil transportation by rail the tank-car was devised and proves both safe and cheap. For sand, coal, ore, etc., the gondola and various types of dump-cars have been developed, handling this class of freight by the simple process of having it slid on by gravity and dumped out by the same force.

At terminals or points where railway and water traffic meet, a variety of freight-handling machinery is always to be found, suited to the local conditions. Great steel bridges, for conveying overhead cars and lifting heavy freight bodily back and forth between the cars on the railway tracks and the vessels at the docks, are common. In many of them a man rides with the car and conducts its operations. Others are operated on the principle of cableways, and still others are essentially cranes or gantries. The Hulett unloaders have achieved great popularity at terminals on the Great Lakes. The old method of handling a lot of freight between car and vessel by crews of men with wheelbarrows is abandoned wherever possible. Machinery has caused a vast reduction in freight-handling costs. Figuring roughly, it used to cost $2 to $3 a ton to shift a miscellaneous cargo; now it is usually accomplished at a cost of less than 25 cents a ton. A record of costs at a large freight terminal, where all sorts of freight are continually transferred from cars to steamships and from ships to cars, showed these figures: Hand trucking 200 feet, 8 cents a ton; loading on box cars, 12 cents a ton; unloading from box cars, 11 cents a ton; loading off-shore ships with package freight, 23 cents a ton; unloading or discharging same, 20 cents a ton. In a modern terminal the vessels run into slips alongside great piers that parallel the entire length, giving close access to every hatchway. There are cranes on the ship and on the pier for hoisting and shifting the cargo. On the piers are lines of bins for separating the freight or for brief storage, while nearby are large storage warehouses for freight that has to wait. Every up-to-date mechanism that makes for easy transshipment is at hand. Portable conveyors are supplied for running bags and packages aboard or off board with a minimum of handling. Electric trucks are becoming as common as hand trucks. The heaviest articles are handled with ease, large machines being shipped all put together in one crate. Every sort of mechanical assistance for freight handling seems to have been thought of and provided, just as in a modern factory.

Statistics.— There are 2,400,000 freight cars employed on United States railways, double the number in 1894, and of three times the total capacity; in other words the cars are one-half larger than they used to be. The average haul of a consignment of freight is 140 miles — less in the Eastern but more in the Western States. The annual mileage of these freight cars is 20,000,000,000, or the equivalent of more than a hundred round trips to the sun, or 40,000 tours around the earth. The ton mileage, that is the number of tons carried one mile, is 264,000,000,000, or the equivalent of 1,400 trips to the sun and back. The average receipts per ton-mile are three-fourths of a cent. A horse will draw a ton a mile in 15 minutes, at a cost of 50 cents for hauling and another 50 cents for loading and unloading; a man can carry a ton in 50-pound parcels a mile in 20 working hours, or two and a half days, yet the railway handles this freight for three-fourths of a cent. As the railway's average haul is about 140 miles, it is apparent that its average charge for a ton of freight is $1. Valuable freight, however, commands much higher figures.

The Interstate Commerce Commission reports the freight movement for the year ending 30 June 1914, in tons, as: Products of agriculture, 98,825,133; animal products, 26,352,289; products of mines, 574,000,013; forest products, 91,093,595; manufacturing products, 142,015,332; merchandise, 40,239,497; miscellaneous freight, 35,934,471; total of United States freight movement in one year, 1,008,460,330 tons. More than half this total is mine products and more than a fourth is soft coal; bituminous and anthracite coal and coke constitute 38 per cent of the total; ores, 9 per cent; stone, sand, etc., 8.5 per cent; lumber, 6.2 per cent; grain, 4.5 per cent; and cement, brick and lime together, 3.8 per cent. No other class of freight is over 2 per cent of the total.

The last census reports the railways as spending $95,000,000 annually for new cars and $437,000,000 for repairing cars. At least 95 per cent of this must be for freight cars, and the great excess of the repair item is evidence that very many cars are rebuilt so much that they might better be classed as new, and that from this point of view it requires about 200,000 new freight cars annually to handle the freight — 100,000 to replace those that wear out and 100,000 to take care of increased freight movement. Since the railway mileage of the United States is about 35 per cent of the entire world mileage, it is reasonable to infer that the above statistics represent about a third of the world's freight movement by rail.

Ocean Freight.—This was originally carried by sailing vessels, and while such transportation is very cheap, it has given way to steam navigation, nearly all the carrying trade being in the hands of regular lines plying between the important ports of the world. The tonnage going out of New York, which is now the world's greatest port, is about 15,000,000 tons annually. In time of peace London and Hamburg each clear about 14,000,000 tons, Liverpool and Rotterdam 12,000,000 each, Hongkong 11,000,000, Shanghai 9,000,000, Rio Janiero 8,500,000, and Marseilles, Singapore, Colombo and Cardiff each 7,000,000 to 8,000,000 tons. The steamship lines follow the same practice as the railways in making rates, putting the price on the valuable freight, and carrying bulk cargo, which is sometimes needed as ballast, at low rates. There are a considerable number of coasters that do a freight business all along the Atlantic seaboard and handle cargoes at rates much less than the railways charge, but railway interests have sought to discourage such traffic by refusing such vessels terminal facilities at the docks. There seems to be an economic loss here, for it is well known that a schooner with a gasoline engine can tow a half dozen large barges between ports on the coast and make money at rates away below what the railways charge; but there is risk in the business and occasionally a string of barges is wrecked by a sudden storm.

The total ocean freight of the world is approximated by the commerce reports. The imports of 31 leading countries in 1912, the best year for comparison, were of $19,000,000,000 value, and the cost of transportation was about $350,000,000. The tonnage is believed to be about 1,000,000,000, of which about 20 per cent now originates in the United States. It thus appears that America is far ahead of all other countries in freight movement, the internal movement here by rail being equal to the entire water movement of the world, and one-fifth of the ocean freight being American though little of it is carried under the American flag.

CHARLES H. COCHRANE,
Author of 'Modern Industrial Progress.'

FREILIGRATH, frī'lig-rät, **Ferdinand**, German poet: b. Detmold, 17 June 1810; d. Cannstadt, Würtemberg, 17 March 1876. His father was a teacher. Though apprenticed to a grocer at 15, he continued his studies and published verses in local journals. In 1831–36 he was a banker's clerk in Amsterdam. In 1836–38 he published a literary journal *Rheinisches Odeon*, became a bookkeper at Berman, but continued writing lyrics, one volume of which he published at Mainz in 1838, and as it proved successful he determined to devote himself entirely to literature. In 1842 he received a small pension from the King of Prussia; but this he retained for only two years, for having embraced views in politics of an advanced liberal stamp which placed him in opposition to the government, he felt bound to resign the benefits of royal favor. At the same time (1844) he published a poem entitled a 'Confession of Faith' (Glaubensbekenntnis), in which he became the champion of the political creed he had adopted. In 1848 three other political poems by him: 'Die Revolution'; 'Februarklänge'; and 'Die Todten an die Lebenden,' saw the light; and the last of these led to his being put on trial for treason. This trial, in which he was acquitted, is memorable for another reason, being the first jury trial ever held in Prussia. From 1851 till 1867 Freiligrath resided in England as manager of the London branch of a Swiss banking establishment. On the failure of the bank a national subscription was got up in his behalf in Germany, and the proceeds of it enabled him to return to private life. The general amnesty of 1868 brought him back to Germany and he celebrated the triumph of 1870 with the very popular 'Hurrah Germania' and 'Die Trompete von Vionville.' The early poems of Freiligrath are distinguished by a wealth of glowing and highly-colored imagery, and by the prevalence of Oriental scenes and subjects. His political poems are too full of the tones of party warfare to live as poetry; but many of his lyrics seem destined to hold an abiding place in German literature. Germany is also indebted to him for many admirable translations from foreign languages, as from Burns, Tannahill, Moore, Hemans, Shakespeare, Longfellow and Victor Hugo. His works were collected in eight volumes and published at Stuttgart (1870–71). There is a volume of English translations of his select poems edited by his daughter, Mrs. Kroeker (Leipzig 1871). Consult Buchner, 'Ferdinand Freiligrath, Ein Dichterleben in Briefen' (Lahr 1881–82); Richter, 'Freiligrath als Uebersetzer' (Berlin 1899); Rodenberg, 'Jugenderinnerungen' (ib. 1899).

FREIRE, frā'rĕ, **Ramon**, Chilean general: b. Santiago, 29 Nov. 1787; d. there, 9 Dec. 1851. He was a grandson of Freire de Andrada (q.v.). He fought in the patriot army in the war for independence (1811–20), and defeated Benevides at Concepcion, 27 Nov. 1820. He became the leader of the Liberals, and upon the deposition of O'Higgins in 1823, supreme director, with dictatorial powers. In 1826 he ended Spanish rule in Chile by expelling the remaining Spanish forces from Chiloé. He was re-elected supreme director in 1827, but resigned not long after. The Conservatives having gained control, he led an insurrection against them, was defeated at Lircai (1830), and banished to Peru. In 1836, he attempted to invade Chile with two ships, but had to surrender, was again exiled to Peru and was not permitted to return until 1842. After his death a bronze statue was erected to his memory by public subscription in Santiago de Chile. Consult Elliot, G. F. S., 'Chile' (London 1907); Mehegan, J. J., 'O'Higgins of Chile, etc.' (London 1913); Torrente, M., 'Historia de la Revolucion de Chile, 1810–28 (in *Collecion de historiadores i de documentos Relativos a la Independencia de Chile,* Vol. III, Santiago de Chile 1900).

FREIRE DE ANDRADA, frā'rĕ dā ändrä'dä, **Gomes**, Portuguese colonial administrator: b. Coimbrà 1684; d. Rio de Janeiro, 3 Jan. 1763. He served in the Portuguese army, and became governor and captain-general of Rio de Janeiro in 1733, his authority extending over most of southern Brazil. His administration of almost 30 years was the most successful and prosperous, as well as the longest, in the colonial annals of Brazil. The gold mines were effectively worked, and colonization was greatly furthered. The war over the boundaries of Brazil and Paraguay was fought during his administration (1754–56). Freire de Andrada was made Count of Bobadilla in 1758. His exploits form the subject of the epic poem entitled 'picos Brasileiros' or 'O Uraguay' (1811), by José Basilio da Gama.

FREISCHÜTZ, frī'shüts, (in German «free shooter») a legendary marksman who makes a covenant with the devil that six balls from his gun shall follow his own will, while the seventh is directed by the devil. The idea was universal about the 15th century, and may be found in the literature of the time and even later. Consult Apel, 'Gespensterbuch' (1810–15) and the opera by Weber, 'Def Frieschütz' (1821).

FREISCHÜTZ, Der, romantic opera in three acts by Carl Maria von Weber (libretto by Friedrich Kind) first produced at Berlin, 18 June 1821. Founded upon a popular fairy story, the plot has an atmosphere of mediæval romanticism heightened many degrees by its musical investiture. Max, a skilful marksman, is betrothed to Agatha, daughter of the head ranger of the Prince of Bohemia. Caspar, who has sold himself to the demon Zamiel, is also in love with Agatha and plots to ruin Max and deliver him over to the Evil One in substitution for himself. He persuades Max to accept his aid to procure magic bullets to win him success in the coming trial upon which his future rests. At the Wolf's Glen, Max joins Caspar and receives from Zamiel seven silver bullets, six for himself and one to be at the demon's disposal. On the eventful day, Max fires his six successful shots. At the Prince's command, he fires the seventh, Zamiel's bullet, at a passing dove. It appears to him as Agatha; but her bridal wreath protects her and Zamiel directs the bullet to Caspar's heart. No opera has a history of greater popular success and none is nearer to the German heart than 'Der Frieschütz' with its folk-spirit and thoroughly national emotional expression. It was the foundation stone of a new school of opera that has vitally influenced the trend of the art even to the present day. The suggestive and descriptive power of the music, the intimate connection between the orchestra and the stage, the rich hues of the instrumental color and the telling and novel orchestral effects, notably in the melodramatic scene of the casting of the magic bullets, form a landmark in the history of the development of music. Wagner's debt to Weber, readily acknowledged by him, was immense. Berlioz, too, learned much from his use of the orchestral instruments. The opera is full of ingratiating melody of a popular nature, much of it pure folk-music (for example, the «Peasants' March» and the «Waltz» in the first act) and all of it expressive of what has come to be known as German romanticism in music. The overture is a model of orchestral scoring, rich, effective and spontaneous. Agatha's great scene and aria «Wie nahte mir der Schlummer» is the musical high-water mark of the opera and in its great variety of moods and rhythms, closely welded, is a clear presage of the continuous music of a later day. The chorus of bridesmaids and the huntsman's chorus in the third act are sung at least wherever German is spoken; and there are many other numbers scarcely less close to the hearts of the people.

LEWIS M. ISAACS.

FREISING, Otho of. See OTHO OF FREISING.

FREISING, frī'zing, Bavaria, town 22 miles northeast of Munich, on the Isar. It contains a cathedral, dating from the 12th century, and a former episcopal palace now transformed into a seminary. There are also a gymnasium, a preparatory school and teacher's training school, and a number of orphanages, homes and other benevolent institutions. Agricultural machinery, stained glass and pottery are the chief articles here manufactured. Freising is of Roman origin and from 724 was the see of a bishop. In 1803 the see was merged with that of Munich. Pop. 14,946.

FREJES, frā'hēs, **Francisco,** Mexican historian: b. Guadalajara, Mexico; d. 1845. He was trained for priestly and monastic life, became known as a Franciscan of remarkable eloquence, but retired from publicity in 1838, and eventually became superior of the monastery of Guadaloupe, near Zacatecas, Mexico. His object in his retirement was the prosecution of historical study, and his works, especially the 'Historia Breve de la Conquista de los Estados Independientes del Imperio Mejicana,' have both value and interest.

FREJUS, frę-zhü', France, town in the department of Var, 15 miles southeast of Draguignan. It was founded by Roman colonists from Massilia (Marseilles), and was again colonized by Julius Cæsar, after whom it was named Forum Julii. Its Roman remains are interesting; there is a pharos, a circus, a viaduct and walls. In the time of Augustus the harbor became the principal naval station in Gaul, but is now entirely silted up. It was the birthplace of Agricola, Roscius and Gallus, and at a later day of l'Abbé Sieyès. Pop. 4,022.

FREKI. See GERI AND FREKI.

FRELINGHUYSEN, frē'ling-hī-zěn, **Frederick,** American lawyer: b. Somerset County, N. J., 13 April 1753; d. 13 April 1804. He was graduated at the College of New Jersey (now Princeton) in 1770; studied law, and was admitted to the bar in 1773. Two years later he was chosen a member of the Provincial Congress of New Jersey. He was a member of the Continental Congress much of the time during the Revolutionary War; served as a captain in the army; participated in the battle of Trenton, in 1777 he became colonel of the New York militia and took part in all the military operations of Washington's army in that year and in the battle of Monmouth in 1778. From 1783 to 1793 he practised his profession, and attained great eminence; in 1793 he became United States senator serving until 1796. He led an expedition against the Western Indians in 1790.

FRELINGHUYSEN, Frederick Theodore, American statesman: b. Millstone, N. J., 4 Aug. 1817; d. Newark, N. J., 20 May 1885. He was a nephew and adopted son of T. Frelinghuysen (q.v.). He was graduated at Rutgers College in 1836, and studied law in the office of his uncle and adopted father and succeeded to the latter's large practice in 1839. He was city attorney for Newark in 1849, and was widely known as counsel of many large corporations, among them the Central Railroad of New Jersey and the Morris and Essex Canal Company. He was one of the founders of the Republican party in New Jersey. He became attorney-general of New Jersey in 1861, serving until 1866, when he was appointed United States senator. He remained in the Senate till 1869, and was regarded as an able debater. In 1870 he was appointed Minister to Germany, but declined the appointment. He returned to the Senate in 1871. He was a member of the Electoral Commission of 1876–77. He succeeded James G. Blaine as Secretary of State under President Arthur in 1881. He was president of the American Bible Society and a trustee of Rutgers College.

FRELINGHUYSEN, Theodore, American lawyer: b. Millstone, N. J., 28 March 1787; d. New Brunswick, N. J., 12 April 1862. He was a son of F. Frelinghuysen (q.v.). He was graduated at the College of New Jersey (now Princeton) in 1804; and admitted to the bar in 1808. In the War of 1812 he commanded a company of volunteers, and in 1817 became attorney-general of New Jersey, which office he held till 1829 when elected United States Senator. In the Senate he was prominent on the Whig side, and was active in the discussions relating to the rechartering of the United States Bank and the withdrawing of the government deposits therefrom, and relating to the tariff. He failed of re-election in 1835 and resumed his practice at Newark, of which city he was mayor in 1837–38. He was chosen chancellor of the University of New York in 1838; was nominated for Vice-President of the United States in 1844 on the ticket with Henry Clay; and in 1850 became president of Rutgers College where he remained until his death.

FREMANTLE, William Henry, English clergyman: b. Swansboro, Buckinghamshire, 12 Dec. 1831; graduated at Balliol College, Oxford, 1853; Fellow of All Souls, Oxford, 1854–63; Fellow and tutor of Balliol College, 1888–94; curate of Middle Claydon, 1855–57; vicar of Lawknor, Oxfordshire, 1857–65; rector of Saint Mary's, Bryanston Square, London, 1865–83; canon of Canterbury, 1882–95. Since then dean of Ripon. He has occupied prominent lectureships and a chaplaincy. He was the author of fully a dozen volumes and editor and translator of the work of others. His most important works are 'The World as the Subject of Redemption' (1885); 'Christian Ordinances and Social Progress' (1901); 'Natural Christianity' (1911). He translated the works of Jerome and Rufinus.

FREMANTLE, Australia, the chief seaport of Western Australia, at the mouth of the Swan River, 12 miles from Perth. The manufactures include aërated waters, boots, soap, furniture, confectionery, etc. In 1914–15 the vessels entering the port of Fremantle showed aggregate tonnage surpassed only, among Australian ports, by that of Sydney, Melbourne, Brisbane and Adelaide, its total being 1,659,697 tons. Pop. of town and suburbs about 22,200.

FREMIET, frā'mĭ-ā, **Emmanuel,** French sculptor: b. Paris, 1824; d. 1910. His early artistic education was received from his uncle Rude. He became lithographer in the Museum of Natural History and official painter of the Morgue. His 'Gazelle' brought him considerable fame in 1843 and he was awarded medals for his animal groups 'The Mother Cat' and 'A Hunting Dog.' 'The Wounded Hound' (1850) created a furore, and is now in the Luxembourg. In 1855 he was commissioned by the emperor to model a series of military statuettes; many of these are now in the Frémiet Barbedienne collection. He was appointed professor of drawing and modeling at the Jardin des Plantes in 1875, and in 1887 received the medal of honor for the celebrated 'Gorilla Carrying off a Woman', which had been rejected at the Salon in 1859. Among other notable groups and statutes by him are the 'Jeanne d'Arc' in the Place des Pyramides, Paris; with copies at Nancy and in Fairmount Park, Philadelphia; 'The Faun' in the Luxembourg; his statues of Napoleon I at Grenoble, the Duke of Orleans at Pierrefonds, the Prince de Condé, the elephant of the Trocadero Fountain, Paris; statues of De Lesseps at Suez, of Colonel Howard in Baltimore. He was awarded the Grand Prix at the Paris Exposition of 1900. At the Saint Louis Exposition of 1904 he exhibited a statue of Saint George, the 'Gorilla of Gabun,' and 'Race Horses.' He was a grand officer of the Legion of Honor, a member of many art societies and of the Institut de France.

FRÉMONT, Jessie Benton, American author: b. near Lexington, Va., 31 May 1824; d. Los Angeles, Cal., 27 Dec. 1902. She was a daughter of Thomas H. Benton (q.v.), and married John C. Frémont (q.v.) in 1841. She published 'Story of the Guard: a Chronicle of the War,' with a German translation (Boston 1863); 'A Year of American Travel' (New York 1878); 'Far West Sketches' (Boston 1890); a sketch of her father prefixed to her husband's memoirs (Chicago 1886); 'Souvenirs of My Time' (Boston 1887); 'The Will and the Way Stories' (Boston 1890). Consult Frémont, J. C., 'Memoirs of My Life' (Chicago 1886); Peacock, V. T., 'Famous American Belles of the 19th Century' (Philadelphia 1901).

FRÉMONT, John Charles, American explorer and soldier: b. Savannah, Ga., 31 Jan. 1813; d. New York, 13 July 1890. His father was a Frenchman and his mother came of the distinguished Virginia family of the Whitings. He attended Charleston College, but was expelled from there for insubordination before completing his course. In 1833 he was appointed teacher of mathematics on board the United States sloop of war *Natchez*, with which he proceeded on a cruise to South America. On his return he gave his attention to civil engineering and in 1836 was one of a company sent out to survey a railway route. He was still engaged in railway surveying in 1837, and at the end of that year was engaged in the survey of the Cherokee lands in Georgia, North Carolina and Tennessee. In 1838–39 he undertook the exploration of the country between the Missouri River and the British frontier in the present States of Iowa, Minnesota, the Dakotas and Nebraska. In 1838 he became a second lieutenant in the United States Topographical Corps. In 1841, in Washington, he eloped with Jessie Benton, daughter of Senator Benton. About this time Frémont proposed to the government to undertake the exploration of the Rocky Mountains — at that day a terra incognita. His plan being approved through the influence of his father-in-law, Senator Benton, he, in 1842, started with a handful of picked men on the first of a series of explorations of what is now the western part of continental United States. Great Britain at that time laid claim to Oregon, and the Southwest was under the domain of Mexico. Frémont reached and explored the South Pass. Not only did he fix the locality of that great defile, but he defined the astronomy, geography, botany, geology and meteorology of that region, described the route since followed, and designated the points upon which a line of United States forts were subsequently erected. He proceeded on a second expedition in 1843 intending to extend his previous work to the westward and join it with the survey done on the Pacific Coast by Captain Wilkes, of the United States navy. He had just reached Westport (Kansas City), from Saint Louis, when an order commanding his return reached the latter city. The assigned reason for the order was that he was taking with him a 12-pounder howitzer without authority. His wife received the order and, instead of forwarding it, sent him a message telling him to get away to the wilds as soon as possible and ask no questions. This time he reached South Pass by another route and from there journeyed to Great Salt Lake, reaching the island now known by his name. He pushed investigations right and left of his entire course, went up the Snake River and journeyed along the Columbia, finally reaching Fort Vancouver where he connected his survey with that of Wilkes' exploring expedition. Later in the winter, without adequate supplies, or a guide, he traversed the wilderness to the Rocky Mountains. In this daring expedition he crossed 3,500 miles of country in sight of eternal snows, discovering the grand features of Alta California, its great basin, the Sierra Nevada, the valleys of San Joaquin and Sacramento and determined the geographical position of the west portion of the North American continent. He came east via Utah Lake, the Uinta River and Brown's Park, reached the North Platte, turned south through Colorado, reached the Arkansas River, which he followed eastward, and arrived in Saint Louis, 6 Aug. 1844. His report created a sensation and 10,000 copies were printed and distributed by Congress and many thousands of copies were issued and sold by private publishers. He was made captain in 1844. His third expedition was quickly organized in 1845 and directed to California in the acquisition of which by the United States it played a prominent part. On this trip he had a force of 60 expert marksmen; he proceeded from Bent's Fort along the Arkansas, the Grand and the Uinta to the Wasatch Mountains, across these to Utah and Salt Lake, thence down to the Sierra Nevada, crossed by the Donner Pass, to Sutter's Fort. The Mexican War was now looming up; Frémont had secured permission of the Mexican officials at Monterey to explore California and New Mexico. This permission was withdrawn within a short time and he was ordered to leave Mexican territory. This order, however, he did not obey but, on 5 March 1846, fortified himself on Gavilan Peak, thus opening the first phase of the war in California. Without being attacked he retreated toward Oregon. In May while on this journey through Lieutenant Gillespie he received special instructions from Washington and returned at once to the Sacramento Valley country. Frémont here found the American settlers in open revolt against Mexico. They had proclaimed the «Republic of California» at Sonoma, and had adopted a white flag with one red stripe at bottom and bearing a star and bear for emblems, hence this is often called «the Bear Flag Revolt.» Frémont took command, and this move created an American military occupation. The naval forces under Stockton and Sloat now entered the fray, raising the flag at Monterey. The United States flag was raised soon after in San Francisco, Sutter's Fort and Sonoma. Stockton made Frémont major of the land forces.

General Kearny arrived soon after the capture of Los Angeles, and co-operated with Frémont and Stockton. Frémont sided with Stockton in the latter's differences with Kearny on the question of senior authority. At this time Frémont was commissioned lieutenant-colonel and soon after was promoted by Stockton military commandant and civil governor of the Territory of California, and in this capacity in 1847 concluded the articles of capitulation by which Mexico ceded exclusive possession of that territory to the United States. In the autumn of 1847 Frémont was tried by court-martial in Washington on several charges arising out of the conflict of authority between him and General Kearny. Frémont was found guilty and sentenced to dismissal from the service. President Polk did not confirm all the charges, and remitted the sentence. Smarting under a sense of having been greatly wronged, Frémont quit the service on 15 March 1848. Later in this same year he organized another expedition to survey a railway route to the Pacific. After enduring terrible hardships and losing 11 of his party he finally arrived in California. He had purchased a large tract of land in 1847 and gold having been discovered on his tract, on his return to California proceeded to develop it. Considerable litigation followed over the title and Frémont finally lost the lands altogether. In 1850 he was one of the first senators sent from California to Washington. In 1853 he undertook his last expedition across the continent, made new discoveries and after many hardships reached California. In 1856 he was the first candidate of the new Republican party for the presidency.

His opposition to slavery cost him the votes of the South and he received but 114 electoral votes while Buchanan received 174. On the outbreak of the Civil War in 1861, Frémont was appointed a major-general of volunteers. He then, as commander of the Western Federal Army, marched into Missouri seeking an encounter with General Price's Confederate force. An unfortunate dispute with a subordinate officer caused the War Department to relieve him of his command. A few months later he was placed in charge of the Mountain Department of Virginia, Tennessee and Kentucky. His division was finally consolidated under Pope, who was Frémont's junior, and the latter declined to serve under him and resigned in 1864. He became involved in the railroad building boom of the late 60's and early 70's and met financial disaster in the panic of 1873. He was governor of Arizona in 1878–81, and in 1890 by act of Congress was made a major-general and placed on the retired list. In July of the same year he died in New York of ptomaine poisoning. In 1906 the State of New York erected a monument at his grave in Rockland Cemetery, Piermont, N. Y. He wrote 'Report of the Exploring Expedition to the Rocky Mountains in the Year 1842, and to Oregon and North California in 1843–44' (Washington 1845); 'Memoirs of My Life' (Chicago 1887); id., 'Souvenirs of My Time' (Boston 1887); id., 'A Year of American Travel' (New York 1878); id., 'The Story of the Guard' (1863). Consult Bigelow, John, 'Memoir of the Life and Public Services of John Charles Frémont' (New York 1856); Carvalho, S. N., 'Incidents of Travel and Adventure in the Far West with Colonel Frémont's Last Expedition' (ib. 1857); Curtis, 'The Republican Party' (ib. 1904); Dellenbaugh, F. S., 'Frémont and '49' (New York 1914); Frémont, E. B., 'Recollections' (ib. 1912); Richman, I. B., 'California under Spain and Mexico' (ib. 1911); Royce, 'California' (Boston 1888); Upham, 'Life of Frémont' (Boston 1856).

FREMONT, Neb., a city and county-seat of Dodge County, in the central eastern part of the State, on the Chicago and Northwestern, the Union Pacific and the Chicago, Burlington and Quincy railroads, 37 miles northwest of Omaha. The town was settled in 1857 and was incorporated in 1871; it has a telephone system, gas works and a municipal water supply and electric-lighting plant. It is an important market for horses, cattle, sheep and swine and has pork-packing establishments, flouring mills, planing mills, machine shops, etc. The educational institutions include a normal school and a business college. There is a Carnegie library; noteworthy also are the courthouse, Lutheran Orphan's Home and high school buildings. Pop. 9,345.

FREMONT, Ohio, city and county-seat of Sandusky County, on the Sandusky River, at the head of navigation, 30 miles southeast of Toledo. In a productive farming, oil and natural gas region, its transit facilities include the Lake Erie and Western, the Lake Shore and Michigan Southern, the Wheeling and Lake Erie railroads, and the Fremont and Fostoria and the Lake Shore electric routes. It is a busy manufacturing centre with extensive water power and produces boilers, engines, cutlery, farming implements, stoves, ranges, electro-carbons, flour, beet sugar, paper, underwear, furniture, etc. The United States census of manufactures for 1914 showed within the city limits 65 industrial establishments of factory grade, employing 2,402 persons, 2,065 being wage earners receiving annually a total of $1,097,000 in wages. The capital invested aggregated $4,086,000 and the year's output was valued at $4,780,000: of this, $2,484,000 was the value added by manufacture. The principal civic features are the State Historical building, the Birchland public library (1873) and parks, chiefly gifts of Sardis Birchard, uncle of ex-President Hayes, the Hayes Memorial Hospital, Y. M. C. A. building, the armory, technical school, the Hayes Memorial Library and Museum in Spiegel Grove State Park, presented to the Ohio Archæological and Historical Society by Col. Webb C. Hayes; the Soldiers' monument, the tomb of Major Croghan in Fort Stephenson Park and the monument on Cemetery Knoll over the graves of President and Mrs. Rutherford B. Hayes. The site of a former Indian village and of a trading post from 1785, Fort Stevenson was built here early in 1812 and was the scene of Maj. George Croghan's defeat of the English and Indian forces 2 Aug. 1813. Known as Lower Sandusky until 1849, the name was then changed in honor of J. C. Frémont; it received a city charter in 1867. Pop. 12,000.

FREMONT PEAK, Wyo., mountain in the granite centre of Wind River Mountains in the west central part of the State, with an elevation of 13,730 feet above sea-level. It was named from General Frémont and was supposed to be the highest peak in the State until Gannett Peak, six miles north-northwest, was found to be 55 feet higher and the remeasurement of Grand Teton gave 13,747 feet for that summit in Teton Range. There is another Fremont Peak in San Benito County, Cal.

FREMSTAD, Olive, American operatic soprano: b. Stockholm, Sweden. At the age of 10 she came with her parents to America and settled in Minneapolis. She taught music in Minneapolis, Duluth, Chicago and New York and went to Germany in 1892 where she studied under Lilli Lehmann. In 1898 she made her début as Azucena in 'Il Trovatore' at the Cologne Opera House. She was subsequently engaged at the Royal Opera House, Munich; sang two seasons at Covent Garden, London; and in 1903 was engaged for the Metropolitan Opera Company of New York. Her success was immediate and overwhelming. She sings in all the principal Wagnerian rôles and also many in French and Italian. She created the part of Salome in Strauss' opera both in New York and Paris. Her best-known rôles are Isolde in 'Tristan and Isolde'; Brünnhilde in 'The Ring'; Kundry in 'Parsifal'; Venus, Tosca, Armide and Salome. She also ranks as one of the world's greatest lieder singers. She has received two decorations from the French government in appreciation of her remarkable achievements.

FREMYOT, frĕm'yō, **J. F., Baroness de.** See CHANTAL.

FRENCH, Alice, American novelist, better known as OCTAVE THANET: b. Andover, Mass., 19 March 1850. In 1878 she began writing on economics and sociology and similar themes but in a short time chose the short story as her special literary vehicle. Her residence in Iowa and Arkansas gave her practically a new field of experience of which she availed herself to the utmost. Her principal works are 'The Bishop's Vagabond' (1884); 'Knitters in the Sun' (1887); 'Otto the Knight' (1893); 'A Book of True Lovers' (1898); 'The Man of the Hour' (1905); 'Stories that End Well' (1911); 'A Step on the Stair' (1913). Her novel 'Expiation' (1890) won high praise. She also edited 'The Best Letters of Mary Wortley Montague.'

FRENCH, Anne Warner. See WARNER.

FRENCH, Daniel Chester, sculptor: b. Exeter, N. H., 20 April 1850. He was the son of the Hon. Henry Flagg French, judge and ex-assistant Secretary of the United States Treasury, who in 1867 moved to Concord, Mass., whence his son attended the Massachusetts Institute of Technology and Dr. Rummer's lectures on anatomy in Boston and received some slight tuition in sculpture from John Q. A. Ward. After a year spent in Florence, Italy, with Thomas Ball, he completed a commission from the town of Concord for the well-known statue of 'The Minute Man,' which was unveiled on the centenary of the battle of Concord, 19 April 1875. From 1876–78 his studio was located in Washington; from 1878–87 in Boston and Concord and after 1887 in New York. His principal works besides 'The Minute Man' of Concord are statues of General Cass, Rufus Choate, John Harvard and Thomas Starr King; 'Dr. Gallaudet and His First Deaf Mute Pupil'; Statue of the Republic; and the Milmore Memorial. Also 'Bust of Phillips Brooks,' Trinity Church, Boston; 'Gen. Wm. F. Bartlett,' Boston; Public Library bronze doors, Boston; 'Francis Parkman Memorial,' Boston; four Custom House groups, New York; statue of Senator Hoar, Worcester; Melvin Memorial and Emerson statue, Concord, Mass.; 'Alice Freeman Palmer Memorial,' Wellesley; 'Governor Oglethorpe,' Savannah, Ga.; 'Marshall Field Memorial,' Chicago, Ill.; statue of Lincoln in Lincoln, Neb.; equestrian statue, 'General Draper,' Milford, Mass.; 'Longfellow Memorial,' Cambridge, Mass.; 'Spencer Trask Memorial,' Saratoga, N. Y.; in collaboration with E. C. Potter, equestrian statue of Washington in Paris, France, and of General Grant, Philadelphia, Pa. He received numerous distinctions, being elected a member of the National Academy of Design, of the American Academy of Arts and Letters and of the Accademia di San Luca, Rome, and honorary president of the National Sculpture Society. Consult Caffin, 'American Masters of Sculpture' (New York 1903); Taft, 'History of American Sculpture' (ib. 1903).

FRENCH, Henry Willard, American journalist and author: b. Hartford, Conn., 1854. He is known as a war correspondent and lecturer and among his writings may be mentioned 'Nuna, The Brahmin Girl'; 'Desmonde, M.D.'; 'Art and Artists'; 'Our Boys in China'; 'Our Boys in India'; 'Our Boys in Ireland.'

FRENCH, SIR John Denton Pinkstone, 1ST VISCOUNT, English soldier: b. Ripple, Kent, England, 28 Sept. 1852. He served in the navy 1866–70, entered the army 1874 and fought in the Sudan campaign of 1884–85. In the Boer War in South Africa (1900) he commanded the cavalry division, directed the operations about Colesberg from 10 Nov. 1899 to 31 Jan. 1900, and commanded the cavalry in the movements that led to the relief of Kimberly in February 1900, and the capture of Bloemfontein and Pretoria. For his services he was appointed to be lieutenant-general. He was made a general in 1907 and field-marshal 1913; was inspector-general of the forces, 1907–11, 1914; and chief of the general staff, 1911–14. As he was one of the signatories to a memorandum to General Gough giving guarantees that army officers would not be called upon to fight the Ulster Unionists — which memorandum was repudiated by the Asquith government — he resigned in March 1914, but on the outbreak of the European War was appointed to command the British expeditionary forces in Belgium and France. After holding that post for a period of 16 months — during which the retreat from Mons took place, and the battles of the Marne, Ypres and Neuve Chapelle were fought — he resigned, was appointed as commander-in-chief of the forces in the United Kingdom, and for his services created a viscount (December 1915). He became Lord Lieutenant of Ireland in May 1918.

FRENCH, Mansfield, American educator: b. Manchester, Vt., 1810: d. 1876. He was educated at Kenyon College, Ohio, and from 1845 to 1848 was president of the Female College, Xenia, Ohio. He was active in the founding of Wilberforce University, the first college for the colored race, as he had been one of the founders of Marietta College. An ardent abolitionist he laid before President Lincoln his plans for the education of the negroes as preliminary to their emancipation. The National Freedman's Relief Association was the realization of his views, as he had stated them at a mass meeting held in Cooper Union, New York, February 1862. He became the agent of this association and did valuable work for the liberated negroes of the South at Port Royal, S. C.

FRENCH, William Henry, American soldier: b. Baltimore, Md., 13 Jan. 1815; d. there, 20 May 1881. He was graduated from West Point in 1837 and served with distinction in the Seminole and Mexican wars. In 1861 he was commissioned brigadier-general of volunteers. He fought in the battles of Fair Oaks, Gaines' Mills, Peach Orchard, Malvern Hill, Antietam, Fredericksburg and Chancellorsville. In 1862 he became major-general of volunteers, and was mustered out of the volunteer service in 1864 after having for a time commanded the Third Army corps. He commanded the Second Artillery 1865–76, first on the Pacific Coast and then at Fort McHenry, Md., and was retired with rank of colonel in 1880. He commanded the forces which suppressed the Baltimore and Ohio Railroad riots (1877).

FRENCH, William Merchant Richardson, American art director: b. Exeter, N. H., 1 Oct. 1843; d. Chicago, Ill., 3 June 1914. He was graduated at Harvard in 1864, and for over 10 years devoted himself to civil engineering and landscape gardening. In 1874, having become greatly interested in art, he was much sought after as a lecturer on art subjects and did some writing on art for various periodicals, and in 1877 began his connection with the School and Museum of Art in Chicago, becoming director in 1879 when it was renamed the Art Institute. He helped organize and build up this institution from small beginnings to its present size and prominence, and was connected with it until his death. He was president of the American Association of Museums.

FRENCH ALLIANCE, The, in American history, an alliance, offensive and defensive, between France and the American colonies, signed in 1778. Three American commissioners, Benjamin Franklin, Silas Deane and Arthur Lee, sent to the court of France at Versailles, obtained recognition of the independence of the United States, and effected an alliance between the greatest European rival of Great Britain and her revolting colonies in America. The treaty stipulated that should war ensue between France and England it should be made a common cause, that neither France nor America would make peace without the consent of the other, nor should either lay down its arms until the independence of the colonies should be established. The news of the alliance provoked great enthusiasm in the American colonies. See UNITED STATES — AMERICAN REVOLUTION.

FRENCH ARCHITECTURE. While in any extended discussion of the architecture of what is France to-day it would be necessary to divide the subject according to the various provinces which were later united under the French monarchy, it seems wiser in so brief an article as this must be to take a more comprehensive survey, referring to provincial differences only when necessary to make clear the more general view. Leaving aside, as not strictly architectural, the rude stone monuments of prehistoric France, especially numerous in Brittany (Carnac, Lochmariaker, etc.), we may best follow the customary division of the subject into the six periods called the Gallo-Roman, Carlovingian, Romanesque, Gothic, Renaissance and Modern periods, each marked by well-defined style characteristics.

I. **Gallo-Roman.**— With the conquest of Gaul by Cæsar (51 B.C.) the Romans began extensive works of public utility. These were especially numerous in Languedoc and Provence, where a large population of Greek colonists had long maintained a high civilization. Here the Romans built roads and bridges (e.g., the Pont du Gard near Nîmes and the bridge of Saint Chamas across the Touloubre), theatres and amphitheatres, city gates, baths, temples and triumphal arches, all of cut stone and admirably executed. Nîmes is especially rich in Roman monuments, including two gates, an amphitheatre, baths and one of the loveliest and best-preserved of all Roman temples, the so-called Maison Carrée (4 A.D.). Arles, with its amphitheatre; Orange, with its superb theatre; Cavaillon and Carpentras, with their triumphal arches; testify to the splendor of this Greco-Gallo-Roman civilization. Further north are other interesting Roman monuments: at Autun two well-preserved city gates, at Lillebonne, fine remains of a theatre; at Rheims, a splendid arch of triumph; at Paris, remains of the palace and baths of Julian (4th century) and of an amphitheatre (the *arènes de Lutèce*). Tombs and memorial columns at Saint Rémy, Cussy, Vienne, etc.; mosaic floors and foundations of villas, city walls, forts, gates, aqueducts and bridges, are widely scattered through France.

II. **Carlovingian.**— From the chaos of the Merovingian era which intervened between the Roman and the Carlovingian dominations, almost nothing remains of architectural work. Possibly the crypt of Jouarre and the much-restored baptistery of Saint Jean near Poitiers belong to this period. It was Charlemagne who began the restoration of civilization and art in France during the early part of the 9th century. Little, however, survives of this period in France: the oldest parts of the church of Saint Généroux in Poitou is of this time, but Charlemagne's greatest works were in the Rhine Valley. The octagonal church at Aix-la-Chapelle is his most important monument; built by Byzantine artificers in imitation of San Vitale at Ravenna, it has been much altered and restored in later centuries. Whatever else has survived is in fragments incorporated into later structures, as in the crypt of Saint Denis, the church of Saint Martin at Angers, in two churches at Vienne and the lower part of the tower of Saint Germain-des-Prés, Paris. The Norman invasions destroyed much of what was standing before 1000 A.D.

III. **Romanesque.**— With the establishment of the Normans in possession of western France (911 A.D.), and the accession of the Capetian dynasty to the French throne (987), there began a new era for France. Out of the social and political chaos were emerging the feudal system, an established monarchy, and the monastic orders (q.v.). It was these orders that revived architecture, for during the 10th and 11th centuries they were the chief refuge of the arts and the chief builders of churches, about which they grouped also many other buildings — cloisters, dormitories, refectories, hospitals, etc., in and upon which they developed the arts of carving, sculpture and painting. Lacking marble and antique columns, but retaining the traditional elements of the basilican church-plan, they were forced to build at first rudely, later with greater elegance, out of coarse stone vaulted churches with massive piers, heavy round arches, small windows and thick walls, in which decoration was reduced at first to its lowest terms. This general style, called the Romanesque, varied greatly in detail in different provinces. Thus in southern France the Roman remains strongly influenced the detail and execution of churches usually of moderate size but fine workmanship (Arles, Aix, Cavaillon, Thor, Vaison, etc.); in parts of south central France domical churches were built, showing Byzantine influence as at Périgueux, Fontévrault, Solignac, Cahors; in Normandy, where development was early and rapid, at first timber roofs, later scientific cross-vaulting appeared, and central towers or lanterns at the crossings (Vignory, Caen, Mont-Saint Michel); while in Burgundy and under Cluniac influence another development of vaulted architecture took place as at Vézelay; and in the Royal Domain and in Auvergne other variations of the general type. Lack of space forbids specifying these provincial variations; what is common in varying degree to all these «schools» is their solid, massive construction, controlled by a clear scientific logic, the absence of applied ornament, the richness of the deep portals with their shafted jambs and carving, the increasing use of symbolic sculpture and grotesques, the use of stepped arches, and in the later 11th and the 12th centuries, the great size of churches like Saint Sernin at Toulouse, Vézelay, the churches at Caen, etc., and their increasing loftiness, with ribbed cross-vaults and elementary buttresses.

IV. **Gothic.**— With the consolidation of the royal authority under Philip Augustus in the late 12th and Louis IX (Saint Louis) in the 13th century, and with the growth of the power of the bishops as opposed to the pretensions of the abbots, there began an activity in the building of cathedrals, — that is, of bishops' churches, — which endowed France with its most splendid monuments in that marvelous style called the Gothic. (See GOTHIC ARCHITECTURE). In this style, which was a logical outgrowth from the preceding Romanesque, a rigid structural logic blended with a vivid artistic imagination, clothing the structural elements of clustered piers, molded arches, ribbed vaults, flying buttresses, pinnacles and traceried windows, in forms of great decorative beauty, enhanced by figure-sculpture, carved foliage, stained glass and a limited amount of painting, and dignified by imposing dimensions and especially by great loftiness. The vault of Notre Dame, Paris, reaches a height of 108 feet; that of Amiens, 136 feet; that of Beauvais, 142 feet. Towers with or without spires,— in some cases it was planned to have seven — added to the majesty of the noble exteriors. The earliest completely Gothic cathedral was Notre Dame at Paris (1163–1235); but the abbey of Saint Denis as first erected (begun 1140), and the cathedrals of Senlis, Noyon, Auxerre and Laon show early and incomplete realizations of the style whose culmination is seen in the cathedrals of Chartres, Rheims and of Amiens, next to which may be named, among others, those of Bourges, Rouen and Tours. These were all practically completed in the 13th century and are all in the northern half of France. During the 14th century building was mostly confined to parish churches, chapels and partial rebuildings of earlier churches, the cathedral of Albi being the only large cathedral of this century. The style became more ornate, less majestic, passing in the 15th century into the highly ornate phase called the "Flamboyant" from its flame-like traceries, as in the exquisite churches of Saint Malou at Rouen and of Saint Pierre at Louviers and the façade of Rouen Cathedral. During this century civil and domestic architecture developed rapidly (Palais de Justice, Rouen; houses of Jacques Cœur at Bourges, of Cluny at Paris); and finally expired in a corruscation of brilliant, overwrought beauty in minor works, as the Renaissance came in.

V. Renaissance.— The Renaissance (q.v.) movement had been potent in Italian art for a hundred years before it strongly affected French architecture. Minor works by Italian artists during the closing decades of the 15th century had been executed in France, but it was not until the military expeditions of three successive kings into Italy — Charles VIII, in 1489, Louis XII in 1499, Francis I between 1515 and 1527 — that the new style began to make its way in France. Italy was at that time far in advance of France in the refinements of civilized life and art and Italian arists were imported as well as Italian works of art by all these three monarchs to domesticate the foreign style on French soil. Here began a long contest between the national French taste and the Italian, and fo. 400 years it has continued with oscillations between the Latin and the Gallic tendencies in design. Surviving fragments of the château de Gaillon (1499, demolished in 1793) and the east wing of the château of Blois built by Louis XII show a mixture of Gothic with Italian details; and while in the tremendous building activity of Francis I and his court in palaces, rural castles along the Loire Valley and churches a large number of Italian artists collaborated with French master-masons, composition and construction long followed Gothic traditions, though the decorative detail approximated Italian models. Thus the church of Saint Eustache (1532) at Paris is purely Gothic in conception but with not a Gothic detail; shafts, capitals, entablatures, arches all following Italian precedent. Even Fontainebleau, of which part (Cour Ovale) was built under Italian direction (Serlio, Primaticcio), and in more striking degree the châteaux of Chambord, Azay-le-Rideau and Chenonceaux, retain the high roofs, dormers, pinnacles and chimneys of the French feudal château, while the superb open staircase-tower of the north wing of Blois is a purely Gothic structure with exquisite Renaissance arabesques. The Renaissance forms are a superficial dress, and while under the Bourbon Henrys (II, III and IV) the Italian influence increased and architectural forms followed classic precedent more closely (châteaux of Ancy-le-Franc, Anet, Pailly, the Tuileries), and Gothic forms disappeared, the French were slow to abandon their preference for the older French ways. The earliest part of the Louvre (1546–59) by Lescot, did more than any other monument to fix the type of French Renaissance architecture for a long period.

Under Louis XIII and especially XIV, the Latin or classic ideals increasingly prevailed (1610–1710), and externally the great domed churches (Sorbonne, Val-de-Grace, Invalides) and palaces and châteaux like the completed Louvre with its magnificent east colonnade, the enlarged Tuileries and above all the colossal palace of Versailles, displayed a style of great stateliness and classical dignity, being admirably composed, but often frigid in their formal regularity. The picturesquely irregular massing of the times of the Henrys and of the earlier part of Louis XIII's reign disappeared entirely. Internally palaces were decorated in a style which, though increasingly capricious, was absolutely French and often displayed great refinement and originality. (See INTERIOR DECORATION). But this freedom degenerated into extravagance and a reaction set in during the second half of the 18th century, culminating under Louis XVI (1784–89), toward greater simplicity and purity within and without. The most notable monuments of this reaction are the colonnaded façades on the Place de la Concorde, the imposing façade of the church of Saint Sulpice and the coldly classical but impressive Panthéon, with its fine dome and very Roman exterior. To this period also belong the Grand Théatre at Bordeaux, the Palace of the Legion of Honor (Paris) and the Petit Trianon at Versailles. Under Napoleon this formal classicism developed into the Empire style and produced such monuments as the Madeleine, the Corps Législatif (Chamber of Deputies) and the Arch of the Carrousel, all in imitation of Roman types, and the superb Arc de l'Etoile, surpassing in grandeur all Roman arches of triumph but copying none.

VI. Modern.— The 19th century began amid both political and industrial revolutions and architecture sank to a low estate in Europe for a long period. In France, however, it maintained still some artistic life, thanks in part to the École des Beaux-Arts, in part to the vitality of the French taste. From 1830 to 1850 it was marked by a sincere effort after Greek refinement without copying of Greek models; the Library of Saint Geneviève, the Column of the Bastille and new wings of the Palais de Justice and École des Beaux-Arts exhibit this tendency, called by some the Néo-Grec. It was less a distinct style than a tendency which affected architecture beneficially long after its particular forms had been given up. When, under Louis Napoleon (the Second Empire) the completion of the union of the Louvre and Tuileries and the building of a new opera house were undertaken, French architecture rapidly advanced to a high degree of artistic excellence, drawing inspiration largely from the Louvre and the style of Henry II. Especially notable was the revival of French decorative sculpture applied to buildings, while the great international exhibitions of 1867, 1878, 1889 and 1900 and the building of new railway terminals greatly stimulated the development of the artistic use of iron and steel construction for roofing over very wide spans and introduced wholly novel types of architectural design. The eccentricities and the forced affectation of originality of the so-called «Art Nouveau» or secessionist movement, though it originated in France, never led to the extravagant monstrosities to which it gave birth in Germany, Austria and Belgium.

Ever since the time of Louis XIV the French have led the world in the creation and adornment of squares and monumental centres in cities, as in the Places Vendome and de la Concorde in Paris, the Grande Place of Bordeaux, the Place Stanislas at Nancy, the Longchamps at Marseilles, etc. In no other country in recent times have the arts of decorative sculpture and painting as auxiliary to architecture been carried to so high a development or practised with such success as in France. While tradition and the unifying influence of the national École des Beaux-Arts have to some extent hampered the free development of new ideas in architecture, on the other hand they have preserved it from anarchy and extravagance, while the sound good taste and artistic sense of the French people have been manifest through all periods of its history.

Bibliography.— The literature of French architecture, in French, is enormous; only a few titles can be given: Berty, A., 'La Renaissance monumentale en France' (Paris 1864); Blondel, 'Architecture française' (Paris 1756); Chateau, L., 'Histoire et caracterès de l'architecture en France' (Paris 1864); Du Cerceau, J. A., 'Les plus excellents bastiments de la France' (Paris 1868); Lechevallier-Chévignard, E., 'Les styles français' (Paris 1892); Palusire, L., 'La Renaissance en France' (Paris 1885); Révoil, H., 'Architecture romane du midi de la France' (Paris 1867); Ronyer and Darcel, 'L'Art architectural en France' (Paris 1869); Sauvageot, C., 'Choix de palais, châteaux, hôtels et maisons de France' (Paris 1867); Viollet-le-Duc, E., 'Dictionnaire raisonné de l'architecture française' (Paris 1876). In English: Adams, H., 'Mont Saint Michel and Chartres' (Washington 1914); Blomfield, R., 'History of French Architecture 1494 to 1661' (London 1911); Cram, R. A., 'The Substance of Gothic' (Boston 1917); Moore, C. H., 'Gothic Architecture' (New York 1899); Mathews, C. T., 'The Renaissance under the Valois Kings' (New York n. d.); Ward, W. H., 'French Renaissance Architecture' (London 1911).

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FRENCH BROAD RIVER, a river of North Carolina and Tennessee, rising in Transylvania County, of the former State, near the foot of the Blue Ridge, flowing northwest into Tennessee, and discharging into Holston River, four miles above Knoxville. It is about 250 miles long. From Asheville to the Tennessee line it is remarkable for its beautiful scenery, flowing through deep mountain gorges, or overhung by high cliffs. In Buncombe County, N. C., are precipices known as the Chimneys and the Painted Rocks. The latter, which are between 200 and 300 feet high, derive their name from some Indian pictures still to be seen on them. Consult Kirke, E., 'On the French Broad' (in *Lippincott's Magazine,* Vol. XXXIV, pp. 425 and 529, Philadelphia 1884).

FRENCH CHALK, a variety of steatite or talc (q.v.) occurring in fine-granular or scaly masses of milky-white color and pearly lustre. It is extensively used by tailors as a crayon for marking cloth, also as an absorbent in removing grease spots and, in powdered form, inside of new gloves and shoes to produce a smooth surface and make it easier to slip them on.

FRENCH CLASSICAL SCHOOL OF POLITICAL ECONOMY. See Economics.

FRENCH EAST INDIA COMPANY. See East India Companies.

FRENCH EQUATORIAL AFRICA. French Kongo — which in 1908 became the General Government of French Equatorial Africa — is a colony of a special nature. Its boundaries were fixed diplomatically before the country was penetrated, as the result of some brilliant exploring expeditions. The conquest was undertaken progressively and pacifically without France being called upon to support those heavy burdens and bloodshed which the establishment of other colonies have sometimes entailed.

We are indebted to those intrepid explorers who started out to unravel the equatorial mystery and who paid the price of their adventurous spirit in loss of health and life in order to add a new page to the colonial history of France. In turn, Commanders Bouet-Wuillaumez and Paul du Chaillu, Ensigns Bravouzec and Genoyer, Aymes, Marche and Compiègne, established from 1840 to 1872 the general lines of definite bases in the hinterland of Gaboon. Shortly afterward, Savorgnan de Brazza, by patience coupled with skill, transformed in the course of three successive missions from 1875 to 1885, the small possession of Gaboon into a very large colony, joining up in a pacific manner that Kongolese depression which constitutes the enormous basin of the Kongo to our Gaboonese possession. Possession had only just been taken when the diplomatic status of the Kongo was settled by an international conference, the outcome of which was the General Act of the Berlin Conference of 26 Feb. 1885, and a series of agreements fixing the frontier boundaries for Germany, established in the Cameroons, for Spain, mistress of the Rio Mouni region, for Portugal, installed in the enclosed territory of Cabinda, and for the Kongo Free State, which afterward became Belgian Kongo. However, a new field of activity was opened up for explorers consisting in the gigantic scheme of presenting France with an empire which would be linked up by way of the Tchad, the banks of the Oubangui River, to the Algerian oases, and by way of the upper Nile region and the ports of Gaboon to the Red Sea stations. In 1890 Crampel marched on Tchad, but the sly hostility of the Sultan Rabah prevented him from reaching it. Dybowski, Maistre and Clozel followed in his wake, and their repeated efforts gradually enlarged the sphere of France's activity in Kongoland. Shortly afterward as the result of a clever junction-movement carried out by the Foureau-Lamy mission coming from Algeria, Joalland-Meynier from Senegal and Gentil ascending the Kongo, France became definitely installed in Tchad in 1900 and Baguirmi, Kanem, Chari and Ouadai were not long before succumbing to its influence. These results were further completed by the Marchand mission, which crossed French Kongo from one to the other, making the junction between the basin of the Kongo and the Bahr-el-Ghazal, and which, following on the Fashoda incident, found its epilogue in the Declaration of 21 March 1899. The pacific conquest of the country was hereafter assured. At Tchad, however, where France encountered the hostility of the well-organized Senoussans and Ouadians and found herself in the presence of troops used to fighting in open country, trained by chiefs like the Sultan Rabah for long periods of warfare, the occupation could not be carried out under the same conditions and took the form of a veritable campaign, of which the battles of Abeché, Bir-Taouil and Doroté and the military operations of Massalit and Borkou were the most glorious episodes. In 1911 French Equatorial Africa allowed France to emerge from the situation wherein she found herself after the Agadir incident, and it was she who, by a mutilation accepted with dignity, finally supported the cost of the operations of 4 Nov. 1911 of which France was to reap honor and profit in Morocco. But although having to accept the inevitable in the scheme of world politics, Equatorial Africa was soon after to have her share of glory, and in the World War, thanks to the valor displayed by the Franco-Britannic troops under Generals Aymerich and Dobell, she has not only recovered the territories taken from her but she now exercises her administrative action in the old Cameroon territory.

French Equatorial Africa is an immense region which extends from the mouth of the Kongo to Tripolitana and from the Atlantic to Egypt, covering an area of 2,200,000 square kilometers (849,420 square miles) or almost four times that of France. Situated between lat. 19° N. and lat. 5° S., its climate is very varied, alternating with the dry and healthy climate of the Saharean countries to that encountered in the wooded forests of the equatorial zone. The inhabitants, numbering some 6,137,000, are no less diversified, from the nomads of the north to the savages living in the forests. Some have a pretense to civilization — at least Islamic — others are still barbarous and in the first stage of human evolution; the former are priests of tribes and turbulent, the latter still ferocious but more docile and more apt for agricultural work. This colony, so rich naturally as regards its soil, so well favored by the variety of its climate and its populations, possesses moreover the most magnificent navigable system imaginable, with the immense Kongo and its great tributaries, the smallest of which are large in comparison with our rivers in France, with the vast Tchad which receives the waters from the Chari and Logone, with the Ogooué increased by the Ivindo, the N'Gounie and the Fernan Vaz. Such a situation is unique in Africa and for Equatorial Africa it is indeed fortunate as not only does this system water and fertilize the greater part of its territory but it constitutes the most remarkable means of penetration, of communication and transport between the different regions.

From a physical point of view, the division of French Equatorial Africa into natural regions gives four large distinct zones: the mountainous zone of the coast basins; the large equatorial depressions of the African plateau; trans-equatorial Kongo of the upper country; and the basin of the Tchad.

The coastal basins each comprise four banks rising one above the other; beyond the maritime bank, the banks of the virgin forests at the top of the first falls, limited at the east by the N'Gounie, the Nyanga and the mid-Niari, then the banks of the grassy plateaux having an altitude of 400 to 700 metres (1,311 to 2,295 feet) and the bank of sandy prairies of the upper plateaux of a height varying from 700 to 800 metres (2,295 to 2,622 feet) and extending as far as the watershed of the Kongo Basin. The principal rivers are the Ogooué (1,200 km., 745 miles), the Kouilou, called the Niari in its upper course; a part of the Kongo (about 600 km., 373 miles, of its length of 4,000 km., 2,485 miles). The Kongo possesses in French territory a certain number of tributaries among which are the Alima, the Likouala, the Sangha (itself swelled by the N'Goko), the Oubangui forming the boundary between French Kongo and Belgian Kongo and itself swelled by the Ibenga, the Lobayem, the Kouango, the Kotto, etc. The Chari River has no outlet to the sea; it finishes in the lake Tchad after having received on its right bank the waters from Bahr Salamat, and on its left those of Bahr-Sara and Logone, of which the confluence is at Fort-Lamy. From an administrative point of view, the decree of 15 Feb. 1910 provided for the definite creation of the general government of French Equatorial Africa, as stipulated by the decree of 26 June 1908. The general government is constituted to govern the following groups of colonies: the Gaboon colony, capital Libreville; the Middle Kongo, capital Brazzaville; the Oubangui-Chari-Tchad colony, capital Bangui, including the military territory of Tchad.

At the head of the colony is a governor-general invested with mandatory powers from the

French Republic and residing at Brazzaville. The colonies composing the group have administrative and financial autonomy; they are administered, under the superior authority of the governor-general, by governors of colonies having the title of lieutenant-governors. The military territory of Tchad was administered by a commander of the territory of Tchad, acting under the direct orders of the lieutenant-governor of Oubangui-Chari-Tchad. The decree of 14 May 1915 specified that the military territory of Tchad should hereafter, under the name of "Tchad Territory," be administered either by a civil official or by the officer commanding the troops stationed there, such functionary to take the title of administrator or commander of the Tchad territory. Decree of 12 April 1916 specified that the chief of the Tchad territory would hereafter be under the orders of the governor-general of French West Africa. A decree of 7 April 1916 — modified by decree of 5 Sept. 1916 — fixed the conditions under which the Cameroon territories would be administered. The governor-general of French Equatorial Africa administers, as commissioner of the French Republic, the Cameroon territories which previously formed part of Equatorial Africa and which had been relinquished by virtue of the treaty of 4 Nov. 1911. Moreover, a governor of colonies is appointed as commissioner of the Republic in the old Cameroon territories.

From an economical point of view, French Equatorial Africa has, during the last 10 years, undergone an important evolution and its prospects are excellent.

The trade returns for the colony in 1892 were francs 5,500,000 ($1,100,000); it rose to a yearly average of about francs 11,450,000 ($2,290,000) for the following period of 10 years, and amounting in 1908, when the general government was formed, to francs 27,000,000 ($5,400,000) and reaching in 1913 francs 57,846,805 ($11,569,361). The trade for the year 1913 — taken as an average year — is divided up as follows: Francs 21,181,768 ($4,236,353) for importations and francs 36,865,038 ($7,373,007) for exportations. Foreign trade played a considerable part in exportations, in fact almost half. The French markets received in 1913 francs 14,389,717 ($2,877,943) of products from French West Africa, while the export figure for other countries was francs 5,728,194 ($1,145,638) for Belgium; francs 3,967,377 ($793,475) for England; francs 3,860,549 ($772,109) for Germany and francs 1,242,031 ($248,406) for Holland. These figures explain why the economical life of Equatorial Africa has slackened since the outbreak of hostilities. Trade fell in 1914 to 28,000,000 and to 22,000,000 in 1915, while there was a slight increase in 1916, the figure being francs 30,533,038 ($6,106,607). The products exported consist of minerals, animal and vegetable products, both of a superior quality. The mineral products of the colony which are found particularly in the Niari and Djoué basins are principally copper (of an exceptionally high grade), zinc and lead. For many years the natives have carried on the extraction of these products, and recently Europeans have systematically exploited same, the exportations amounting to 8 tons in 1910, 1,271 tons in 1913 and 1,451 tons in 1914.

French Equatorial Africa is rich in big game. Elephants are especially sought after on account of the value of their ivory. The exportation of the latter has remained stationary during recent years, varying between 130 and 150 tons, and eight-tenths of the ivory exported was sold before the war, on the Antwerp market. The exportation of whale oil represents a new and interesting factor, amounting to 10,603 tons in 1913, which, however, fell to 6,771 tons in 1914. Of all the French colonies, French Equatorial Africa is the richest from a forest point of view, possessing as it does a considerable choice of woods suitable for various uses. Mahogany is found in different grades, such as okoume which forms an excellent counter-veneer wood much used in Germany for the manufacture of cigar boxes; semi-hard wood such as kambala, walnut from Gaboon, billinga, hard woods like crail, moabi and mowingui, soft wood like fromager, gombo-gombo and tulip tree wood. The area of these compact forests is some 140,000 square kilometers (54,054 square miles). It should be noted, moreover, that three-quarters of the present forest production of Gaboon was consumed in Germany and Holland. During the year 1916 it was proposed to use wood from Gaboon for the needs of the army and for reconstruction work in the devastated regions of North and East France. Wood exports which scarcely amounted in 1898 to 2,886 tons reached 10 years later nearly 70,000 tons and in 1913 amounted to 150,688 tons, representing a value of francs 8,319,239 ($1,663,847). This result, obtained in so short a time, is most encouraging for the future of this industry.

Rubber is also found in French Equatorial Africa but the proper cultivation of this product has not yet been undertaken in these colonies. The recent world wide rubber boom was felt in French Kongo as elsewhere but this was only of temporary duration and should not interfere permanently with the normal development of this industry. The exportation for 1912 and 1913 was 1,901 tons and 1,600 tons respectively; in 1914 it dropped to 600 tons, increasing in 1915 to 1,413 tons. There is an abundance of palm oil in French Equatorial Africa but it is only exploited in a rudimentary way by the natives. Several large European establishments have been founded for the operation of this industry and its future would appear to be very promising. The exportation of palm oil only amounted to 76 tons in 1912 and 77 tons in 1913; there were 359 tons of palm almonds exported in 1912 as against 208 in 1896, 595 in 1913 and 971 in 1914, thus showing an upward tendency which reached, in 1915, 1,135 tons. Gum copal of various qualities is found in French Equatorial Africa but its exportation is insignificant (1,490 kg. [3,278 lbs.] in 1913). Raphia is also exported in small quantities, as well as fibres called "piassawa" which are used in the brush trade and the exportation of which amounted in 1915 to the interesting figure of 490 tons which is promising for the future of this industry. Among the principal cultures, the foremost are coffee and cocoa. The coffee tree grows in a wild state in many parts of Equatorial Africa, especially in the Kongo islands, the Sangha and the Oubangui; the local coffee is much appreciated by connoisseurs but no great traffic has yet been undertaken in this product. Its exportation merely amounted to 33,593 kg. (73,904 lbs.) in 1913. The climate and the soil of Gaboon, similar to that of the San Thome Island, are suited to the cultivation of cocoa and many experiments have been made in this direction within the last 20 years. The exportation of cocoa exceeded in 1913 158 tons; in 1914 it amounted to 142 tons and in 1915 actually reached 203 tons despite the difficulties of transportation. Finally, food producing plants are found in French Equatorial Africa such as the banana, tapioca, rice, etc., as well as medicinal plants (castor oil, kola, etc.); pepper, spice, etc., are also grown.

From the foregoing it will be seen that French Equatorial Africa is characterized by the variety and abundance of its products. Its great ivory reserves, its rubber trees, superior and more abundant to those of West Africa, the richness of its soil which is suited for all tropical cultures, its splendid palm forests and precious wood, the immense variety of its ordinary wood, its large herd of cattle in the north, the minerals found in its soil, its copper mines situated at less than 300 kilometers from the coast, all furnish a sure guarantee of the future prosperity of French Equatorial Africa which will quickly be on a par with French West Africa and Madagascar and from which France will derive great advantage. The colony must, however, be liberated from those impediments which at present hinder its full development. From a territorial point of view Equatorial Africa is the only one of the French colonies where the régime of granting large land concessions was put in practice in 1899 and which since 1910 has proved of much benefit to the colony. From a fiscal point of view the colony has suffered from a duality of the customs régime which is still further aggravated by the fact that a large part of the colony is subject to the international stipulations laid down in the Berlin Agreement by which it is deprived of the liberty of its tariffs.

FRENCH ESTABLISHMENTS IN INDIA, the five colonies of Pondichéry, Karikal, Chandernagar, Mahé and Yanaon. The total area is 196 square miles. These colonies are divided into five *dépendances* and 17 communes, having municipal institutions. There is also an elective general council. The governor of the colonies resides at Pondichéry. The colonies are represented in the Parliament at Paris by one senator and one deputy. The principal crops are paddy, ground nut and ragi. Pondichéry has five cotton mills and there is a jute mill at Chandernagar. The cotton mills employ 7,335 persons. There are also in operation two oil factories and a few oil presses for ground nuts, two ice factories and a cocoatine factory. Oil seeds form the chief export from Pondichéry. At the ports of Pondichéry, Karikal and Mahé in 1914 the imports amounted to $1,509,126 and the exports to $6,860,702; 292 vessels of 555,561 tons entered and 288 of 568,666 tons cleared from these three ports in the same year. Forty-three miles of railroad are in operation, Pondichéry to Villapuram, and Peralam to Karikal. Pondichéry, the chief French possession, was founded by the French in 1674, taken by the Dutch in 1693, and restored in 1699. The English took it in 1761, restored it in 1765, retook it in 1778, restored it a second time in 1785, retook it a third time in 1793, and restored it in 1814. The population in 1914 was estimated at 273,000.

FRENCH ESTABLISHMENTS IN OCEANIA, islands scattered over a wide area in the eastern Pacific. They are administered by a governor with an administrative council consisting of certain officials, the *maire* of Papeete, and the presidents of the chambers of commerce and agriculture. The establishments consist of the *Society Islands,* the most important of which are Tahiti and Moorea, the former with an area of 600 square miles and 11,691 inhabitants, the latter with an area of 50 square miles and 1,564 inhabitants. Other groups are the *Marquezas Islands,* with a total area of 480 square miles and 3,424 inhabitants, the two largest islands being Nukahiva and Hivaoa; the *Tuamotu group,* consisting of two parallel ranges of islands from King George's Island on the north to Gloucester Island in the south, their total population being 3,828; the *Leeward Islands* (Iles sous le Vent), of which the more important are Huahiné, with a population of 1,230, Raiatéa and Tohaa, population 3,347, and Bora-Bora-Maupiti, population 1,295; the *Gambier, Tubuai* and *Rapa* islands; the Gambier group, of which Mangareva is the principal, has six square miles of area and 1,533 inhabitants; the Tubuai (or southern) Islands, of which Rurutu is the largest, Raivavae, Rimatara and Rapa, have a combined area of 115 square miles and about 2,550 inhabitants. The total area of the establishments is estimated at 1,520 square miles, and their population in 1911 at 31,477, of whom 26,219 were natives and 975 Chinese. In 1903 it was decreed that separate islands or groups should no longer be regarded as distinct establishments, but that all should be united to form a homogeneous colony.

The most important of the islands is *Tahiti,* whose chief town is Papeete with 3,617 inhabitants, of whom 1,909 are French. Pearl and mother-o'-pearl are important products. The island is mountainous and picturesque with a fertile coastland bearing coconut, banana and orange trees, sugar-cane, vanilla and other tropical fruits, besides vegetables of temperate climes. Cotton, coffee and tobacco are now little cultivated. The chief industries are the preparation of copra, sugar and rum. The imports in 1913 were valued at $1,685,390 and the exports at $1,703,590. The chief imports are tissues, wheat, flour, metal work, and the chief exports are copra, mother-o'-pearl, vanilla, coconuts and oranges. There is a monthly steamer service connecting San Francisco, New Zealand and Australia with Papeete, the Tuamotu Islands, the Marquezas and the Leeward Islands. Shipping between the islands is carried on by sailing boats.

Consult Haurigot, G., 'Les Establissements francais en Océanie' (Paris 1891); and Hort, D., 'Tahiti, the Garden of the Pacific' (London 1895). Also *Le Journal Officiel des Etablissements Français de l'Océanie,* published annually at Papeete.

FRENCH FURNITURE. See FURNITURE, MEDIÆVAL.

FRENCH GUIANA, French colony situated on the northeast coast of South America, in 4° 56′ 20″ N. lat. and 54° 41′ W. long.

French Guiana has an area about the third of France. Three chains of mountains run through the country parallel to the coast: the Tumuc-Humas ranges (1,250 to 2,500 feet), the central chain (650 to 1,300 feet) and the coastal chain (200 to 950 feet). A large number of water courses intersect the country. They flow from south to north, throwing their waters into the Atlantic Ocean after being swelled by several tributaries or creeks. The more important of these rivers are the Maroni, Mana, Sinnamary, Kourou, Cayenne, Conté, Mahury and Oyapoc.

Climate.— The temperature is not as hot as is generally supposed; it varies between 25° and 30° C., but it has a weakening and depressing effect on account of the humidity of the atmosphere, the hygrometric degree exceeding 90 per cent. The dry season lasts from June to November, the wet season during the other seven months of the year. The capital of the island is Cayenne, at the mouth of the river of that name, and the port can accommodate ships of 500 tons.

History.— Guiana was discovered by Christopher Columbus in 1498 but it was not until 1500 that Vincent Pinçon first explored the coasts. During the 17th century numerous European expeditions were carried out in Guiana. In 1604 Rivardière landed on the borders of the Mahury, in 1643 Poncet de Bretigny made an expedition to the Cap du Nord; in 1652 Equinoctial France was explored. In 1654 the Dutch took the budding colony and kept it for 10 years, but de la Barre expelled them in 1664 and took possession in the name of the Grande Compagnie des Indes Occidentales. In 1667 the English made a surprise attack on Cayenne, devastated the country, and withdrew. In 1676 it was again occupied by the Dutch who were, however, expelled by the fleet of Admiral d'Estrées.

Numerous attempts to colonize the place were unsuccessful on account of poor means of organization, the Kourou expedition being the most disastrous and ending in a veritable fiasco which contributed in gaining for Guiana an unmerited reputation which has seriously handicapped its development. However, thanks to the efforts displayed by men like Melouet, Guizan and Touat, better results were obtained and the country was in a flourishing condition for several years. When the Second Republic — to its eternal honor — abolished slavery on 27 April 1848, the negroes excited with their new liberty refused to work and the problem of labor became the crucial question in Guiana as in the West Indies for the development of the rich natural resources of the country. Since 1854 the discovery of gold mines resulted in a general exodus to the great forests where the «placers» are; the plantations which had survived so many vicissitudes were abandoned and serious efforts were necessary to place agricultural development on a proper basis again. Moreover, memories of the unfortunate Kourou expedition had a disastrous effect on the colony and was still further aggravated by the dispatch later on of exiles to Cayenne and Sinnamary as the outcome of the Fructidor incidents in September 1797. Since that time Guiana has been considered the dumping ground «par excellence» for deportations and in 1854 the colony was officially designated as a penal settlement.

Government.—At the head of the local administration is a governor, assisted by a privy council. Guiana is represented in the Chamber of Deputies but not in the Senate. From an administrative point of view, the colony is divided into communes each of which is administered by a mayor assisted by a municipal board.

Commerce, Trade, etc.— The trade of the colony for 1913 amounted to 24,717,302 francs, made up of 12,494,765 francs, imports, and 12,-222,537 francs, exports. Its business has not been much affected by the war, amounting to 20,989,045 francs in 1914 and 21,543,502 francs in 1915. (Franc = 19 cents United States currency; for general purposes of comparison, 5 francs=$1).

Gold mining is the principal industry of Guiana, the amount of gold dust exported representing a sum of 10,149,115 francs in 1913. The gold is exported almost exclusively to France and Switzerland — 2,388 kilograms of a total of 3,758 kilograms, Switzerland receiving 1,362 kilograms. Martinique received the remaining 9 kilograms of precious metal (kilogram=2.20 lbs.).

Agricultural products do not enter much into the commerce of Guiana. Cocoa in berries is exported to an amount of 15,241 kilograms (34,000 pounds), and coffee beans 720 kilograms (17,000 pounds), valued at 2,521 francs ($504.20). «Cayenne» pepper, which is now merely a trade term for this condiment, could be much more remuneratively exploited. Bananas, manioc, food producing plants, potatoes, yams and maize give good results nearly everywhere in the colony.

The forests, very rich in valuable wood, are as yet but little exploited. Rosewood was exported in 1913 to an amount of 44,676 kilograms of a value of 1,116,900 francs. Exotic woods were exported to an amount of 244 stères, representing a sum of 36,616 francs; most of the wood found in Guiana is superior to the European woods both as regards hardness and rupture resistance; the wacapou is used in the construction of railroad ties, the wapa is employed in France as props for the growing of vines. Apart from the wood other products are found in the forests, some of which are quite valuable, such as oily products, aromatic products, dye products, gum and resinous products, textiles and medical products. Balata gum is exported to an amount of 217,982 kilograms, representing a value of 653,946 francs. A fairly good trade is also done in raw hide, 35,040 francs, raw feathers, 2,760 francs, air bladders, 10,095 francs, and rich phosphates, 127,720 francs.

With the exception of gold prospecting, Guiana is only partially exploited, the extraction of gold having caused other industries to be almost entirely neglected, or at least relegating to a secondary place other rich minerals or vegetables which could be developed to the profit of the colony. It is, moreover, believed that silver exists in Guiana, as well as copper, lead, iron, tin, mercury and numerous precious stones such as topazes, chalcedones, grenats, amethysts, etc.

From every point of view, whether as regards mineral exploitation or rich forestral or agricultural products, Guiana is in a position to satisfy all demands made on it for colonization. The colony should accordingly show much improvement in a not too distant future, especially when the gold seekers will be joined by workers on the land. It should not indeed be forgotten that in a country so well endowed as Guiana, pasturage and tilling are the very essence of its existence and future prosperity.

FRENCH GUINEA, gin'ĭ, colony comprised in the government-general of French West Africa. It is situated on the coast between Portuguese Guinea and the British colony of Sierra Leone, and extends inland so as to include the territories of Dinguiray, Siguiri, Kouroussa, Kankan, Kissidugo and Beyla. The area is about 95,000 square miles and the population (1914) 1,810,059, including 1,166 Europeans. It is a rich colony, exporting not only cattle, peanuts, gum, hides, beeswax and rubber, but also palm kernels and palm oil. There is an experimental garden near Konakry, the capital, where the culture of bananas, pine apples, rubber trees and other plants is being tried. Futa Jallon contains cattle in abundance. Gold is found in the river Tinkisso and in the Bouré and Siecke districts. The French Guinea Railroad runs from Konakry to the Niger and thence to Kankan, a distance of 412 miles. At Konakry there is a new breakwater 1,066 feet long. In the colony there are 2,225 miles of telegraph and 48 miles of telephone line, with 6 miles of submarine line. The chief port is Konakry, where ocean-going vessels discharge their cargoes at the wharves. In 1915, 408 vessels, of 338,420 tons, entered the ports of the colony. Its imports in the same year were valued at $1,870,033, and its exports at $3,134,414. A regular system of government schools has been introduced here as in the rest of French West Africa. Konakry has regular communications with Europe through two French, one English, and one German line. The 1916 budget of the colony amounted to $1,365,480. Consult Aspe-Fleurimont, 'La Guinée Française' (Paris 1900).

FRENCH AND INDIAN WAR. See Colonial Wars in America.

FRENCH INDO-CHINA. History.— France lost India in the 18th century. In the 19th century she conquered eastern Indo-China. Although the territory is much smaller and less peopled than that of Hindustan, it is in no sense a compensation to be disdained. A colony which is half as large again as the area of France, with a population estimated at 16,000,000, of which 30,000 are French, which is situated at the very door of China — that incomparable market with a population of 400,000,000 — is a colony of very great value and justifies, despite its infancy, all the hopes which have been lavished on it. As has been quite rightly stated, it was not a war of 100 years but a slow penetration of Frenchmen into Indo-China extending over a century. However, the real conquest is of quite recent date. In 1870, Cochin-China and Cambodia alone belonged to France. Tonkin, Annam and Laos were acquired under the Republic. Here again a fortunate coincidence obliged France to take action: its ministers, with the exception of Jules Ferry, who had a clear insight into the future, followed not without uneasiness the rulings of fate. The real pioneer of the French in Indo-China was Pigneau de Behaine, a vicar in Cochin-China and bishop of Adran, who persuaded the emperor of Annam, Gialong, to have recourse to Louis XIV's aid against the Chinese. This premier intervention resulted in the signing of the Treaty of Versailles between Louis XIV and the son of Gialong in 1687, and by which France received the Bay of Tourane and the island of Paulo-Condore. The French officers, appointed to the court of Hué, formed a disciplined army which defended Annam against the English during the Revolution and the Empire. Chaigneau, the last survivor, died in 1822, having received the title of consul of Hué which was conferred on him by the Duke of Richelieu. Later on, however, a changed and hostile attitude was adopted toward the French and this spirit of persecution became extremely violent on the accession of Tu-Duc who deemed the French to be the implacable enemies of his country, describing them as "people who bark like dogs and run away like goats." Tu-Duc in fact became so menacing and defiant that the two European powers most directly concerned, France and Spain, decided to dispatch a small squadron, under Admiral Rigault de Genouilly, in 1847. A further intervention took place at Tourane in 1852, under the reign of Tu-Duc, as a result of the murder of several missionaries; this was followed in 1858 by the dispatch of a Franco-Spanish expeditionary force which took possession of Tourane, and later of Saigon, in 1859. But the wars in which the French Empire was engaged in Italy and China diverted momentarily the attention of France. Tourane was taken and Saigon blockaded. In 1861, Admiral Charner, at the head of a properly equipped expedition, which included but few Spaniards, conquered a part of Cochin-China. On 5 June 1862 Admiral Bonard signed at the "Camp des Lettrés" a treaty by the terms of which the three oriental provinces of the Mékong Delta, Saigon, Mytho and Bien Hoa, were ceded to France. A few years later (1867), Admiral Grandière completed the conquest of Cochin-China by seizing all the important places and the Emperor Tu-Duc surrendered at the Temple of Plumg-Tien, repenting and declaring himself guilty of "having neglected to perform my duties and having been incapable of preserving the patrimony of my forefathers intact." Thus the six provinces of the Mékong Delta were definitely occupied and Cochin-China became a French possession. Already, in April 1863, King Norodom, in order to be freed from the harsh vassalage of Sian and Annam — anxious to exploit the Cambodia country — had signed a protectorate treaty with Admiral Grandière. But larger schemes were conceived and at the time when the English were seeking a trade route to China via Irawaddy or the Salouen, the French wondered if the Mékong, by the very length of its course, would not open up a still easier way. The Doudard de Lagree mission soon found out, however, that this large river was not particularly practicable for penetrating into the Chinese Empire. It was a French merchant named Jean Dupuis who discovered a shorter route, the Red River, which led directly to the province of Yunnan, one of the richest and most densely populated of southern China. However, Jean Dupuis was molested by the Tonkin mandarins and Lieut. Francis Garnier was dispatched to Tonkin with 80 men to settle the incident, with the help of a high official of the Court of Hué. As a result of the bad faith of the mandarins he decided, despite the small forces at his disposal, to attack the citadel of Hanoi, which he took on 20 Nov. 1873 after a brilliant battle. In 20 days he was master of the whole of the Red River Delta; but the Annamites were not long in reacting, all the more so as they had the superiority in numbers; Francis Garnier was lured to his death on 21 Dec. 1873. Hostilities ceased at the beginning of 1874 on the arrival of Lieut. de Vaisseau Philastre who signed a disastrous treaty with the court of Hué by which France lost Tonkin, merely retaining a few commercial and diplomatic rights in Annam. The signing of this treaty assured relative tranquillity for a few years. But little by little the hostility of the Annamite mandarins to the French grew to alarming proportions and the emperor of China declared that he would not recognize the treaty of 1874. Commandant Rivière, who was appointed to bring them once more to reason, committed the same sublime stupidity of his predecessor, Francis Garnier, only to meet the latter's fate at Nam Dinh where he was endeavoring to repel the multitudes who were besieging it. The prestige of France had received a serious set-back. By unanimous decision the Chamber of Deputies decided «to avenge the glorious servitors of France» and the necessary credits were voted. But the campaign, carried out on the system of «small drafts,» was long and costly and the country understood but little the importance of colonial expansion. It required all the eloquence and civic courage of a Jules Ferry, backed by the dauntlessness of the army and navy, to secure this flourishing colonial empire for France.

Events succeeded each other in rapid succession; General Bouet installed himself at Hai-Duong, Admiral Courbet took the important town of Hué, and France's old enemy Tu-Duc recognized by the convention of 25 Aug. 1883 a French protectorate over Annam and Tonkin. However, Chinese pirates, or the «Black Flag,» were not alone in infesting Tonkin, for in addition there appeared the band of the «Yellow Flag» or Chinese regulars. It was against China itself that France was called upon to fight. General Millot, in charge of the Tonkin expeditionary forces, took Bac-Ninh, Hung-Hoa and Tuyen-Quang in 1884. Courbet conducting a campaign in the river passes of the Min, eventually took up quarters in Formosa and in the islands of Pescadores, and by a process of starvation forced China to treat for terms (1884-85) at the very time when General Briere de l'Isle delivered Tuyen-Quang and repulsed the Chinese to the north as far as the Kwang-Si district, after two months severe fighting. It is to be regretted that his right-hand man, General de Negrier, was wounded at Langsan and his successor, Colonel Herbinger, ordered a too hasty retreat which became a rout. This regretable incident although unimportant in itself supplied the long sought after excuse for the adversaries of Jules Ferry for demanding his resignation from office (30 March 1885). As a matter of fact the «Grand Tonkinois» could easily have revealed the terms of the forthcoming peace negotiations, but he preferred to lose his office rather than commit a diplomatic indiscretion. Negotiations, already begun by Commandant Fournier, were carried on by the representative of France, M. Patenôtre, resulting on 9 June 1885 in the signing of the final Treaty of Tien-Tsin by which China recognized the French protectorate over Tonkin, thereby opening up to French trade the rich Chinese provinces of the south: Yunnan and Kwang-Si. This treaty caused serious riots at Hué and necessitated the intervention of General de Courcy in Annam. The young rebel king was only subdued after a long campaign, being finally captured in 1888. Since that period France has had to assert its authority by undertaking numerous campaigns against the Annamite and Chinese rebels, who alone profited by a state of war. Operations were long and laborious, culminating in 1889 by the submission of the principal rebel chiefs. In 1904 the success of the Japanese in the Manchurian campaign naturally had its repercussion in the Asiatic world, although the immediate effect on Indo-China was not very great. Up to 1913 order reigned, with only slight local troubles, and at the end of 1913 the death of De Tham, who lived a secluded life in the mountains and forests of the Upper Tonkin regions, liable to fall at any moment into the hands of the militia, marked the close of the period of banditry with which France had had to contend ever since the conquest of this country. The adversaries of French domination in Indo-China from that time onward seem to have had recourse to the more scientific and violent weapons of modern revolutions. But the rapidity with which the plots were discovered and repressed, the manner in which justice was meted out by the «Criminal Commission» and the calm dignity displayed by the French population, made a profound and lasting impression upon the minds of the Annamites. In the last 12 years French Indo-China has become enriched by the inclusion of two more important territories, increasing its population by almost 1,000,000 inhabitants: the Kwang-Tchu-Wan territory, leased to France for a period of 99 years by the Franco-Chinese agreement of 10 April 1898, and the long disputed provinces of Battanbang, Siem-Reap and Sisophon, restored to Camboda by the Franco-Siamese agreement of 23 March 1907. In this manner was realized the progressive expansion of France in Indo-China, an exceptionally intricate and difficult enterprise if it is borne in mind that France was called upon to subdue and equitably govern a large and homogeneous population having a racial affinity with neighboring peoples not particularly well disposed toward France, i.e., Chinese, Siamese, etc. She had, moreover, to parry the great danger to its ideas of expansion arising from the contact of the people in the peninsula with an adjacent empire of several hundreds of million souls where the frontiers are not protected by any mountains of importance.

Area.— The total area of Indo-China exceeds 800,000 square kilometers (308,880 square miles); it is geographically bordered by the Annamite mountain chain, on its two sides, west and east, and by the lower valleys and deltas of the two rivers which form boundaries: The Red River and the Mékong River.

Topography.— Indo-China is crossed from south to north by a long range of mountains which join and form a cluster in the Tibet region, branching out fanwise from the north to the south, dividing the country into two large valleys which constitute the basins of the Mékong and the Red River. This mountain range entirely covers the Laos and spreads over the Tonkin as far as the Red River in high plateaux of an average height of 1,200 to 1,500 metres. From this block a long chain extends toward the south, the Annamite Cordilière, the spurs of which cut Annam up into a series of small valleys, the communications between which are difficult. Toward the southwest and the south, the Cordilière spreads into large plateaux a few of which extend to the boundaries of the Cambodia and Siam. The abundant rain from the monsoons in Indo-China has resulted in numerous water courses being formed which, except in the Annam centre, have their low and high seasons in winter and summer respectively. The rain is so frequent in this latter season that floods occur which are often of a disastrous character. The two large rivers of Indo-China, the Mékong and the Song-Coi or Red River, collect the waters and their alluvions form the deltas where the economical life of the colony is centred. The Mékong, an important river, has a length of 2,400 kilometers (1,460 miles) of which lake Tonlé-Sap, at the top of Pnom-Penh, forms a natural regulator. The Song-Coi is swelled by the Claire River and the Moire River whose vast delta encompasses the richest provinces of the colony.

The coasts of Indo-China have the form of an S and extend over a length of 2,500 kilometers (1,508 miles); they are rocky where the mountains are near the sea, low and flat by the side of the deltas. They afford good ports but the harbors are either too shallow or insufficiently sheltered.

Climate.— The climate of Indo-China is hot and damp; there are two seasons: summer, which is very rainy, and winter much less so. This difference is due to the monsoons or periodical winds which are prevalent during summer, blowing either from the southwest to the northeast (Cambodia, Cochin-China, Laos) or from the southeast to the northwest (coasts of Annam and Tonkin), and during winter from the northeast to the southwest. The climate, moreover, greatly varies according to the districts. In reality no Indo-Chinese, properly speaking, climate exists, but Indo-Chinese climates according to whether it is a question of Cochin-China, Cambodia, Annam or Tonkin.

Population.— The Indo-Chinese population is of great variety. Peopled during many centuries, Indo-China has witnessed numerous invasions or migrations resulting in a great cosmopolitan race having sprung up. The Annamites constitute at least five-sixths of the total population, being estimated at about 12,000,000. Then come the Cambodians, numbering about 1,300,000, or representing 7 to 8 per cent of the total population. The Thais or Lactians from Upper Tonkin form a total of 600,000 to 700,000 individuals, and the Khas district contains a large number of peoples spread over the Annamite mountain country. There also exist in Indo-China some other peoples who were probably the first to inhabit the country, but they were not strong enough to resist the Annamite invaders, the Cambodians or the Thais, and were obliged to seek refuge in the mountainous regions of the west and southwest. They are classed together under the general name of "the savage population" or Mois. The Chinese are very numerous in Indo-China and their importance is still more considerable than their number would appear to warrant. Finally, the number of Europeans taking up residence in Indo-China increases yearly.

Government.—At the present time the political organization of Indo-China is that of an adult colony. The decrees of October 1887 and 31 July 1898 created the Indo-Chinese union, centralising in the hands of a general governor the superior administration of the colony of Cochin-China and the protectorate of Cambodia, Annam and Tonkin. Nowadays the general government of Indo-China comprises five distinct regions: Cochin-China, capital Saigon, over which France exercises direct authority; Annam, capital Hué; Tonkin, capital Hanoi; Cambodia, capital Pnom-Penh; the three latter are protectorate countries where the rights of the sovereigns and the authority of the native officials appointed by them are respected; Laos, which can be considered as French territory despite the presence at Luang-Prabang and in other parts of this country of native princes or chiefs who continue to exercise over the population, with the consent of France and under its control, certain vestiges of suzerainty.

The territory of Kwang-Tchu-Wan possesses its own administration. The powers of the governor-general are set forth in the decree of 20 Oct. 1911; he holds mandatory authority from the French Republic for the whole of French Indo-China and is assisted by a general secretary and a government board. The various countries comprising the general government of Indo-China possess their administrative autonomy with certain reservations; they are each administered under the superior authority of the governor-general by a lieutenant-governor in Cochin-China, by superior residents in Tonkin, Annam, Cambodia and Laos, and by an administrator in the territory of Kouang-Tchu-Wan. Apart from privy and protectorate councils operating in Cochin-China, Tonkin, Annam, Cambodia and Laos, other deliberating or consultative assemblies exist in the various countries of Indo-China; such as the colonial board of Cochin-China (an emulation of the "Conseils Centraux" in the mother country), and the municipal boards of Saigon, Hanoi and Haiphong. The receipts and expenses of the general government and of the various countries composing French Indo-China are grouped in a general budget in which the common receipts and expenses are given, and in local budgets relative to each particular colony. The countries which constitute the Indo-Chinese Union are divided into provinces, at the head of which are placed administrators of the civil services who take the title of residents in the protectorate countries and government commissioners in Laos. It should be noted that besides the French administration there is always the native administration. The Tong-doc, the Tuan-phu, the Phu and the Huyen still govern respectively in Annam and Tonkin the provinces and circumscriptions; the consultative native chamber and the provincial councils of Tonkin have been given new powers by the local decree of 19 March 1913; Cambodia also possesses its native consultative assembly and in the Laos district the government commissioners have as assistants «Mandarins,» if not like the other countries of the union, native chiefs who by their situation and authority are most useful auxiliaries.

No French colony is more densely populated than Indo-China, none possesses a richer soil, so suitable for the most varied products or more abundant and intelligent labor. Its resources are immense. A European can, if he takes proper hygienic precautions, easily live in the country which is not too close to the swampy regions of the coast, or the forests of the interior. These conditions explain the rapid development made by Indo-China from an economical and commercial point of view since French occupation.

Live Stock.— The distance of Indo-China from France does not allow of the exportation of live stock and for the present the preparation of preserved meat is the only form in which Europe has benefited from its cattle breeding industry. According to the latest estimates drawn up in 1916, the Indo-Chinese livestock amounted to no less than 634,525 head of oxen, 523,553 cows, 289,939 calves, 618,939 buffaloes, 631,709 female buffaloes, 334,024 buffalo-calves, 2,662,534 pigs. The skins and horns of the oxen and buffaloes give rise to a certain amount of exportation (3,000 tons of raw hide in 1913). Silk is exported to an amount of about 100,000 kilos (220,000 lbs.), but a large quantity of the silk produced is employed for local uses. The «stock-laque,» an insect product, may later on give rise to a good business.

Fisheries.— Indo-China, with its 2,500 kilometers (9,650 miles) of coast, its large rivers, its numerous arroyos and especially the great lakes in the Cambodia region, is essentially a country suitable for the fishery industry on a large scale. Deep sea and river fishing permits of the exportation of a large quantity of dried and salted fish, of by-products and of fish oil. The government grants concessions of fishing rights from which it derived a revenue estimated at 500,000 piastres for 1915. The value of the fish exported from Indo-China gives 12,000,000 for Cambodia, 3,000,000 for Annam and 200,000 to 300,000 for Tonkin; the totality of fishing products exported for 1913 amounted to 18,000,000 francs ($3,600,000). Another local industry allied to the fishing trade is the preparation of different fish sauces, the most noted of which is the nuoc-mam.

Other Products.—Among the vegetable products, fatty matters hold a prominent place. The exportation of copra fluctuates between 6,000 and 8,000 tons. Arachide is cultivated in Annam where, however, it is mostly consumed locally. Castor oil, the exportation of which has increased from 42 tons to 600 tons, is principally shipped to China. Cotton oil is also cultivated locally. Rice is the principal crop of Indo-China and is consequently exported in large quantities. Indo-China is second only to Birmania as regards rice exports, being more important than Siam. Laons and Annam do not export rice and Cambodia only in small quantities (about 150,000 tons), but Tonkin exported in 1915 250,000 tons and the figures for Cochin-China — the principal exporter — were 1,295,000 tons in 1914 and 1,085,000 tons in 1915. Rice is treated at Cholon, the big Chinese town near Saigon. Maize was first exported in 1904 and from that time its cultivation has considerably increased, being classed at the present time third in the list of exportations, accounting for nearly 16,000,000 in 1913. Arrowroot, manioc and soja are cultivated for local consumption.

Sacchariferous plants, such as the sugar cane, are grown throughout Indo-China, and especially in Annam. The sugar palm is highly interesting, its sweet juices being estimated at 200,000 hectoliters (5,200,000 United States gallons) a year.

Textile raw materials are abundant. Cotton is cultivated nearly all over Indo-China for the local use of the inhabitants. The cotton from Cambodia is greatly valued by the spinners but practically the whole of the exportation — some 5,000 tons — is dispatched to Japan. Kapok is found in Cambodia in the proximity of the native habitations. Jute is not much cultivated in Indo-China; the local production is used by the natives for manufacturing mats. Ramia is not extensively cultivated and the Annamites use it for making fishing nets. Bambous are treated for paper pulp. Cane is abundant and Indo-China exports from 2,000 to 3,000 tons to Singapore. Mats from Tonkin — the manufacture of which is exclusively carried on by the Chinese — represents an exportation exceeding 800,000 tons.

Spices and condiments are found in Indo-China. The exportation of pepper for 1915 amounted to 4,007 tons, spices to 800,000 tons in 1913, while cinnamon amounted to 1,500,000 tons for the same year.

The rubber crop has fallen off during recent years, the natives having imprudently cut all the creepers. Hevea Bresiliensis has been much developed in Cochin-China; this is also found in southern Annam and in Cambodia, the area planted amounting to some 14,179 hectares (35,000 acres) representing 4,626,000 trees and the exportation reaching 914 tons in 1913, or a value of 962,708 francs ($192,541). The Indo-Chinese rubber plantations have a brilliant future before them. Coffee is principally exported from Tonkin, showing an average for the five years 1910 to 1914 of 1,815 hundred-weight. The average annual exportation of tea is 900 hundred-weight. Tobacco is cultivated all over Indo-China for local consumption, but the French Régie — which imports nearly 30,000,000 of tobacco from abroad — did not forget Indo-China which exported to France in 1913 tobacco, in various forms, amounting to 865,000 francs ($173,000). The principal commercial aromatic plant is the aniseed tree, the fruit of which is used mostly in the manufacture of the liquors known as «Anisette» and «Absinthe.» The exportation of this product amounted to 230 tons in 1913, of a value of 2,500,000 francs ($500,000). The general resources of the country in vegetation comprise medicinal plants, such as cocoa, dye-producing plants such as indigo, and fruits, such as bananas, pineapple, lemons, papaws, etc.

Forest Products.— The forest resources of Indo-China are of an infinite variety. Teak is abundant and is exploited in Luang-Prabang. The exportation of wood to Europe — which will certainly increase when Indo-China woods are better known, is already considerable for teak, «lim» and «chô.» The figure for 1913 was 3,875 tons, of a value of 798,000 francs.

The geological exploration of Indo-China has been begun methodically, but is far from being complete. The mines at present worked are the following: fuel in Tonquin and Annam, zinc in the Tuyen-Quan Lang-Hit Chodian region, tin in the Pia-Ouac district, antimony in Vinh and gold at Bong-Nieu. The value of the mineral output in 1915 was 15,980,000 francs ($3,196,000) and was exported to an amount of 12,632,000 francs ($2,526,000).

Since the war, Japan is the principal market for coal. The production, which was 371,000 tons in 1913, reached 540,000 tons in 1915. The output of the zinc mines for the same year amounted to 34,300 tons, exceeding the last five-yearly average, which was 29,000 tons. The production of tin amounted to 425 tons. Antimony from Vinh shows an exportation of 413 tons, representing a value of 95,000 francs ($19,000), and gold was exported from the mines of Bong-Nieu to an amount of 344,000 francs ($68,800) or 98 kilogrammes. Indo-China, which in the past relied on its agricultural industry for prosperity, possesses in its soil inexhaustible resources for a brilliant future.

Commerce and Trade.— The general trade returns for Indo-China for the year 1913 amounted to 651,697,321 francs ($130,339,464) or 306,238,068 francs ($61,247,613) for imports and 345,259,253 francs ($69,051,850) for exports. If the import statistics are analysed, i.e., those relating principally to cotton tissues, cotton threads, silk tissues, petrol, jute, beaten gold, porcelain, tea and flour, the figures show that France accounted for 107,086,468 francs ($21,417,293) and other countries for 194,931,643 francs ($38,986,328). Exportations to France amounted to 77,631,581 francs ($15,526,316) and 261,935,838 francs ($52,387,167) to other countries. The principal products exported are rice, tin, maize, cotton thread, dried fish, raw skin, pit-coal, leather, pepper and zinc. The trade movement in Indo-China showed a considerable upward tendency from 1904 to 1913, and despite the present conditions prevailing in Europe, Indo-China continues to prosper, as evidence of which we quote the figures for 1915–16: Imports, 334,955,000 francs ($66,991,000) and 390,981,000 francs ($78,196,200) exports, or a total of 725,936,000 francs ($145,187,200). After the war, therefore, great hopes may be founded on Indo-China, which, being a long way from the theatre of the war, has suffered somewhat in its imports — which is but natural — has nevertheless been able to continue to produce and satisfy her clients in the Extreme Orient, as well as those situated in other parts of the globe.

FRENCH KONGO. See French Equatorial Africa.

FRENCH LACQUERWORK. See Lacquers and Lacquerwork.

FRENCH LANGUAGE. See France.

FRENCH LAW. See France — Law and Jurisprudence.

FRENCH LITERATURE. See France.

FRENCH OCEANIC COLONIES. See Gambier Islands; Marquesas Islands; New Caledonia and Dependencies; New Hebrides; Society Islands; Tahiti.

FRENCH PAWNSHOPS, Government. See Government Pawnshops in France.

FRENCH POLISHING, a process, generally employed for giving a smooth surface-coating to furniture and cabinet-work. The surface of the wood being finished off with glass-paper and placed opposite the light, the rubber (a ball of wool covered with rag), dipped in the varnish (or polish), is passed quickly and lightly over the surface in the direction of the grain of the wood, and rubbed till dry. This operation must be repeated several times. The most common of the varnishes known under the name of French polish are prepared as follows: Pale shellac, 5½ ounces; finest wood-naphtha, 1 pint; dissolve. Before applying any of these varnishes the rubber must be first slightly moistened with raw linseed oil. See Varnish.

FRENCH PROPHETS, the English name for a group of Camisards, who arrived in England from France in 1706. Their leaders were Cavalier, Durand-Fage and Marion. The group laid claim to several extraordinary gifts, including that of prophecy, of tongues and of working miracles. They preached communistic doctrines, gained several converts for a time, and declined gradually. Consult Vesson, 'Les prophètes Camisards à Londrès' (Paris 1893).

FRENCH REVOLUTION, The. There are several revolutionary periods and events in French history which stand out prominently from the national records; but the Revolution of 1789 is, by common consent, known as The Revolution. This is because it marks, for the French people, the parting of the ways and forms the most prominent landmark along their pathway of progress. Behind the Revolution is autocratic France with its cynical abuses, profligacy, immorality and disregard for the rights of all but the governing class. On this side of the Revolution is modern France, forceful, imaginative, ever hopeful, working out her own political and social future along democratic lines which her far-seeing public and literary men laid down more or less clearly fully a century and a half ago, principles which served as a beacon light to the struggling American colonies in their fight for freedom, and unified the New World provinces of Spain against the incompetency and non-progressiveness of autocratic Spanish rule. Wherever democracy has made any true advances since 1789 it has been in the name of the principles of the French Revolution. This is why France is still to-day looked upon with peculiar affection by all the republics and democratic nations of the earth, why she was, from the beginning of the European War, the central figure in the immense drama played upon the stage of the world. France has been rightly called the mother of republics and of democracy, though the outbreak of the Revolution took place 13 years after the declaration of American independence. This is due to the fact that intellectually the Revolution had been going on in France for years before the fall of the Bastile, an event which symbolizes the high tide of public resentment against the autocratic and unjust acts of the irresponsible rulers of France during the pre-Revolutionary period. The growth of the principles announced by the Revolution is, in fact, the history of the rise and fall of the autocratic power of the French sovereigns; and it is the symbol of the revolt of the nation against the accumulated grievances of two centuries.

Pre-Revolution France.—After the breaking up of the Roman Empire, Europe became split up into many principalities and a few larger powers. All these political bodies were frequently at war with one another; and the country suffered from the unsettled condition of the age and the lack of anything like unity of aim. The whole of Europe was overrun with robbers and military, many of whom were not much better than robbers. Little by little the kings of France, whose power, in the beginning was very shadowy, succeeded in conquering the different principalities now included within modern France, and consolidating the government of the whole country under one royal head. But though this had been done the government of the sovereigns of France was still far from arbitrary; for the nobility retained very extensive power, and throughout the rural districts the communities practically governed themselves without the interference of the central authorities. The peasants had preserved the memory of their freedom and local autonomy under later Roman rule. This spirit was shown in 997 when the peasants of Normandy conspired against the oppression of their masters, proclaiming the equality of man. In 1224 the peasants of Brittany, under very similar conditions, revolted; and a most desperate and bloody war ensued before the nobility got the upper hand. Some cities had actually preserved their independence since the days of the Romans; others had purchased freedom from needy nobles; while others had boldly fought for and won independence in local government. This spirit of independence grew as the wealth of the country increased. But there was no unity in all these concessions or different forms of local government, each of which thought only of securing its own advantages and liberties. So when the French sovereigns had finally broken the power of the great barons and established the sovereignty and power of the Crown over all France, they turned their attention to the communes, as these local governments were called. Louis XIV consolidated all this power in his own person and became virtually autocratic ruler of France. The consolidation of the power of the nobles in that of the sovereign was beneficial for the country as it tended to make it a united nation, which it in no sense was previous to this extension of the sovereign power over the whole country. This concentration of power enabled the sovereign to do away with many abuses from which the peasantry and the middle classes suffered at the hands of the nobles. But all this was not done without a long and interesting battle. The independent princes and barons having been subdued by playing one off against another, the "king's peace" was established throughout the land for which universal laws were made instead of local observances. Francis I (1515–59) largely increased the royal power. He refrained from calling together the States-General; and he proceeded to divest them of power by taking each separate entity by itself; and he forbade the Parliament of Paris to "meddle in affairs of state or any other matters except those of justice." He set the fashion for the building of magnificent palaces and residences in imitation of those of Italy; and the nobles and the rich generally followed his example all over the land. Extravagance became fashionable at court. But the States-General were not dead. In 1576 they so seriously threatened the authority of Henry III that he was forced to side with them. Thus the struggle went on, sometimes quietly, sometimes openly, until Louis XIV proclaimed the doctrine of absolutism "I am the State," and succeeded in as nearly making good his boast in this direction as any other sovereign of Europe. . He not only believed in it himself, but he made France believe in it and he succeeded in getting the Church to teach it. During his long reign (1643–1715) the States-General were never called together. He did away with state and municipal liberties; and by an edict passed in 1683, the financial management of the cities of France was placed in the hands of the royal intendants. Under Louis XIV municipal life became a thing of the past. Thus every attempt was made, unfortunately for the royal family itself, to incapacitate the French people for democratic ideas or self-government. The king himself became the centre of all life, whether court or municipal. He destroyed the independence of everything but himself. To please his own vanity he patronized the brilliant literary men, philosophers and thinkers of his day, who all shone in his reflected glory. These very men, practically all of whom belonged to the middle classes, represented the rise of that class which Louis further encouraged by advancing them in industry and commerce as well as literature. Boileau, Racine, Molière, and the other brilliant thinkers of the age, were digging the grave for the autocracy that their royal master was so sedulously upbuilding. The middle class was also advanced in the Church. All these factors were with the sovereign; but the very fact that they were indicated a breaking away from the old policy of the value of blue blood and long ancestry. The king even raised illegitimate children of princes and nobles to power. Brilliancy, debauchery and profligacy distinguished the court, while the peasantry remained in ignorance, wretchedness and poverty. The long and costly wars of the reign of Louis XIV and the extravagance of the court, coupled with the vast scale on which royal palaces and other edifices were constructed, had already, toward the end of the reign of the king, placed the country deeply in debt. Monopolies, trade and commerce restrictions and the quartering of soldiers on the populace increased this misery of the peasantry and the middle classes; and the constant plundering of the unpaid military made life unbearable. In many districts the peasantry had become almost savages. But the king was set against all reform. Fènelon, exiled to Greece for suggesting the improvement of the condition of the masses, from there proclaimed that "governments are made for the governed," one of the first signs of the coming revolution. This excessively angered the king, who did not know that he was himself playing the principal part in the greatest tragedy of the age (though he thought it a royal drama) when he was fostering the brilliant lights of poetry, drama, history, art, philosophy and science; for they embodied the idea of liberty of thought which was destined to ultimately destroy the doctrine of autocracy and the divine right of kings.

The very power that the king was putting into the hands of the middle class to serve as a foil against the ambitions of the princes and nobles, while it served his day, built up a resistance on the part of the masses against which royal autocracy was pitiably powerless when the great test came in 1789; for the middle classes had got rich and ambitious and were strongly imbued with the idea of protecting themselves and their own interests and property from exactions on the part of the nobles and the sovereign. The sum of the national intelligence had risen enormously during the reign of Louis XIV and with it the power of national resistance had increased proportionately. The very organization that the king had given to literature, with Colbert as Minister, in order to control it, gave it a dignity and influence that it had never before possessed and enabled it to reach the great and growing middle class. The boldness of the writers and thinkers of the age presaged the coming revolution. Molière, Boileau, La Fontaine, Voltaire were names that were on every one's tongue. They attacked the vices and follies of their age and respected only what their royal patron wished respected. Thus, in the reign of the most absolute of all French monarchs, the leaven of democracy was industriously working; and the independence of thought shown by the great writers of the court was interpreted by each community and each separate interest in its own way and from its own point of view; so that, when the climax of the great drama came, the French intelligence had been quickened to a point perhaps greater than that of any other nation in Europe. This explains the sudden and ceaseless activity of the French people following the fall of the Bastile and the brilliant organization, innovations in government and sociology and masterly strategy in war with which they astonished the whole civilized world. All this was the legitimate result of that spirit of inquiry which began early in the reign of Louis XIV and continued with increasing impetus throughout the reigns of his successors. It was during this long period that was born the eager, earnest, venturesome, serious, witty, sympathetic France such as we know her to-day; for the autocratic sovereigns of the French people were working better than they knew or suspected.

The Struggle with Autocracy.— The death of Louis XIV left as heir to the French throne a boy of only five years of age, and the regencies and ministers of his minority worked together unconsciously to discredit the system of autocracy which the late sovereign had built up during his long reign. The dignity and regal splendor of the court gradually disappeared and cynicism, debauchery, frivolity and reckless extravagance took their place. Pleasure of the worst kind became the great god of the French court and of the nobility; and this evil permeated the body of the ever-increasing wealthy middle class. The debt of the court and the nation increased by bounds. The autocratic judicial system which Louis XIV had attempted to force upon the nation had worked as all artificial systems are apt to work; but in this case the effects were especially bad because the system was disorganized, disjointed and ineffective owing to a bewildering diversity of laws and customs which still held sway over France. In fact autocracy in the administration of the law was only a name in so far as any intelligent sovereign direction or administration was concerned. None of the officers of the law were paid by the sovereign and they were forced to help themselves as best they could. The French courts, as a result, became known as the «halls of robbery.» Over 300 different *customs* or series of local law codes were in use in France at this time. Hence the whole nation, with the exception of the sovereign and the nobility, groaned under this burden of legal injustice and oppression, which had made the securing of justice the most expensive thing in France. Corruption became so great in every branch of the royal and court service that only a comparatively small part of the money extorted from the public in the way of taxes, fees and fines ever reached the royal treasury, though the odium of the system rested upon the Crown which had farmed out the collection of its revenue. The revenue farmers got their concessions through favorite courtiers and powerful nobles. Thus courtiers, nobles and revenue farmers grew rich at the expense of the taxpayers, who consisted of the middle class, since the lower class was too poor to pay anything and the nobility and the clergy found means to avoid contributing to the purse of the nation and the court.

The Church itself was in a position which tended to divide it against itself; for the upper clergy alone profited by the exemption from taxes, the control of a large part of the land of the country and special privileges extended to the Church by the court. The lower clergy were miserably poor, all the lucrative and honorable offices in the Church being almost altogether in the hands of the nobility or sons of rich middle class families who had wealth enough to pay for special privileges and dignities. Thus, on the eve of the Revolution, France was in reality divided into two nations which had nothing in common with one another, the possessors and the dispossessed. So great had become the gulf dividing these two classes; so heavy the burden and so grievous the condition of the dispossessed, that it was only a question of time when the slumbering fires that burned in the subterranean depths of the nation should burst forth into volcanic passion. This discontent of the masses was increased on account of the burdens and interference under which industry and commerce groaned and the restrictions placed upon the right to work at whatever trade or occupation one wished to. The possession of nearly all the land of the country by the Crown, the nobles and the clergy and the excessive taxes on all rented land had led to the rapid decline of agriculture and to the consequently increased poverty of the agricultural population and the control of agricultural products by a few unprincipled jobbers working in the interests of a handful of nobles with special privileges from the court, ruined the peasant farmers and frequently brought on want in a land of plenty. This general misery of the masses and exploitation of the industrious middle classes soon began to have its influence upon the court and the government which were unable to obtain money enough to meet the growing expenses of the administration of the affairs of the nation and the increasing robbery of the public treasury. Finally, in 1787, the court, to avoid calling together the States-General, through which alone the national purse could be reached, finally compromised matters by calling an Assembly of the Notables, who were more inclined to look after their own interests than to help the court out of its financial troubles. Brienne, the Minister of the Crown, won over the Parliament to his ends by promising to call together the States-General (1788); and this was actually done the following year by his successor, Necker, because of the financial troubles of the government. But, in the meantime, the whole interest of the nation had become centred in the meeting of this the only representative body of the whole French people. The States-General met in 1789, under very different conditions from what it had assembled in the past; for now the Third Estate, as the representative body of the non-nobles was called, had become the representative of a rich and powerful section of the country which had been paying the bills of the nation for many years. The interest of the masses in their representatives, as the members of the Third Estate were called, increased from hour to hour. Clubs of many kinds were formed in Paris and all the more important towns of the country to further the interests of the middle classes. These were the forerunners of the democratic and revolutionary clubs that became so notable after the fall of the Bastile. The public unrest found a leader in Mirabeau, a brilliant orator and man of initiative, force of will and character, who was trusted by the people, notwithstanding his noble birth, because of the determined stand he had taken in their behalf. He went about the country stirring the people, by his fervid eloquence, to action in defense of their rights.

The States-General opened at Versailles on 5 May 1789; and they soon proved that they were in no mood to play the rôle the Crown had set apart for them. After considerable wrangling between the three orders which composed it, the clergy, the nobility and the Third Estate, the deputies of the latter declared themselves a «National Constituent Assembly» (17 June 1789). This was done in protest against the action of the other two orders in refusing to act with them in any measure or in any way, holding themselves above the representatives of the people. This action was equivalent to a declaration of war in the sense that it meant that the commons had decided to maintain their rights at all costs and against all opposition. Their attitude coupled with the evident joy with which it was welcomed by the populace of Paris and the surrounding cities and country aroused the court and the nobility to their own danger; and they met in secret session, locking the doors against the Third Estate. The latter at once met in a tennis court, where all the members solemnly swore not to disband until they had secured a constitution for France. This was the signal for the lower clergy, who formed the great majority of the priests, to join the commons and to throw open the church of Saint Louis to them. There the assembly, though warned by the king to disperse, declared the inviolability of its members and defied the sovereign. Louis XVI realizing the danger of the situation, persuaded the other two orders to yield to the Third Estate; and a truce was patched up. The commons had won out. But the contest was not over. The court threw troops around the city. The following day all Paris showed that it was with the Third Estate in no half-hearted way; and the electors of the city constituted themselves an administrative body (13 July). They formed a guard of the citizens which, in a few hours, reached 80,000 armed men. In fear, the king withdrew the troops. Again the commons had won out. The following morning the excitement of the populace, which already realized its power, reached fever heat. The mob attacked the Bastile, the emblem of autocratic power and oppression, and captured it; murdered the provost and several others, and putting their heads on pikes marched in parade about the city. The Revolution was in full swing; and the court and the nobility were powerless to withstand it, for arbitrary government had long ago deprived the upper classes of all organization and power of resistance.

The news of the fall of the Bastile spread rapidly over the whole country. In fear the nobles hastened to relinquish all their privileges, seigniorial, ecclesiastical and jurisdictional; and their ancient rights were restored to the municipalities. The day might have been saved for the royalists had they known how to handle the situation. But they thought only of regaining their lost privileges by force of arms; and to this end they plotted in secret. This came to the ears of the people and they hastened to Versailles and forced the king to accompany them to Paris, and with him went the queen and the assembly. All three found themselves in the hands of the revolutionists (6 October), who from this time on, with justice, continued suspicious of the good faith of the king and the court. On the anniversary of the taking of the Bastile an immense crowd assembled in the Champs de Mars took the oath of fidelity to the new Constitution; and among them were the king and Lafayette, commander of the National Guards of the kingdom. The excesses of the ultra-revolutionists increased from day to day and the plottings of the nobility and the court kept pace with it. Thus the two extremes of French society drew rapidly apart. The queen, Marie Antoinette, urged the king to assert his rights. The populace replied with the establishment of all kinds of clubs which became more revolutionary from hour to hour. Finally the royal pair decided to escape from France and to appeal to the sovereigns of Europe to help them restore the kingly power in France (20 June 1791). They had already had the promise of large bodies of troops from Austria, Spain, Prussia, Switzerland and Piedmont. The royal household were stopped in their flight, at Varenne, and sent back to Paris under guard. As a result of this attempted escape, the king was deprived of all power and placed under guard (17 July 1791); but on his accepting the new Constitution and solemnly swearing to strictly observe it, he was restored to power (14 Sept. 1791). There is no reason to believe that the king did not mean to keep his word. But he was not a strong enough character to force the nobles to keep faith with the Revolution.

The Terror.— The demands of the Constituent Assembly and the Constitution of 1791 were moderate and wise; France might have been saved the terrible days that followed had some strong leader arisen among the nobility; but the curse of absolutism long continued had rendered them powerless and inert and incapable of clear thinking and leadership. So all the activity and genius for leadership remained with the masses. This was unfortunate, for it assured the throwing to the winds eventually of all moderation. The new Constitution formed a basis upon which all parties might have easily agreed and worked for the restoration of order throughout the nation. It provided that there should be but one legislative assembly to hold office for two years, after a general election. In it were vested the sole right to make all laws and to carry on the war. The Constitution also provided for universal suffrage. These were very moderate provisions; but they were looked upon with great disfavor by the foreign governments of Europe which were still strongly royalistic. This gave encouragement to the plotting nobles at home and to the non-juring priests and emigrés abroad who stirred up the growing feeling against France in the foreign courts. A coalition of foreign kings was formed against France and their troops crossed the French frontier. In vain Louis appealed to them to withdraw the troops; they refused, and war began, a war that was to last 23 years, to engulf all Europe and to change the very nature of the French government and people. France, on her part, declared war against Austria on 20 April 1792. The king, while pretending to side with the French people, was secretly treating with the coalition. The Duke of Brunswick, commanding the Prussian army, issued a proclamation to the effect that he was coming to restore the king of France to his ancient power and dignity; and threatened dire punishment on all who dared oppose him (26 July 1792). The mob rose in Paris, and marching upon the Tuileries forced the deposition of the king and his imprisonment. This placed the ultra-revolutionary Commune of Paris, with Danton at its head, in control of the affairs of the nation. The report of the success of the Prussians in the north of France was the signal for the first outburst of ferocity on the part of the Commune, which proceeded to massacre wholesale prisoners of all classes, to the cry of "first get rid of the enemy at home" (2-6 September). This was followed by the proclamation of the republic by the Convention (20 September). Louis XVI was tried by the Convention for conspiracy against the nation, convicted and executed (21 Jan. 1793). This act brought England and the Netherlands into the coalition against France, and it created among the political parties in France itself an unlimited distrust of one another. This resulted in the most frightful atrocities perpetrated in the name of the safety of the republic. The guillotine became the best-known public office in France; untold victims were fed to it in all the cities, among them being Marie Antoinette, the queen (16 Oct. 1793). After the death of the king, the Convention became divided against itself; and the two dominant parties in it, the Girondists and the Montagnards, contended for supremacy and for different political aims, the former seeking to restrain the excesses of the Revolution, the latter seeking to push them to the extreme. The whole south of France rose against the Convention, which replied by suppressing liberty of trade, commerce and action and by throwing into prison over 300,000 suspects. The Girondists having gained the upper hand in Paris and the greater part of the country began to quarrel among themselves; one party wishing to make the Terror the government of all France and the other wishing to restrain the ferocity of their own followers. The Terrorists gained the upper hand, and Danton, Hérbet and their followers were arrested and executed at the instigation of Robespierre and his followers. The Terror became madness, and over 1,200 people were executed in one month. Robespierre became alarmed at the tempest he had himself stirred up and attempted to restrain it, with the result that the Commune ordered his arrest and execution together with that of many of his followers (27-28 July 1794). This final excess was followed by a reaction and the Convention supplanted the Commune. The prisons were opened; the Terror began appreciably to diminish; and the principal authors of the massacres were punished or exiled. The government of the Convention obtained notable military successes against the allies and the French rebels in the south everywhere except on sea. One of its first acts had been to abolish the Constitution of 1793 and to vest the executive power in the Council of the Ancients; and the Council of Five Hundred, the duty of the latter being to propose the new laws, and that of the former to pass upon them and to accept or reject them (1795). In the meantime, royalist plots were thickening and the result of one of these was to incite the National Guard to attack the Tuileries where the Convention was in session. Napoleon Bonaparte, then a lieutenant, defended the place, and put the Guard to rout. This feat and his previous services won him the command of the Army of the Interior and shortly afterward that of Italy. The government of the Directory continued to grow weaker and more incapable, and its incompetency had already plunged the country in debt. The emigrés who had in great numbers plotted almost openly for the overthrow of the revolutionary government returned in large numbers. The armies of the republic, which were republican to the core, had been almost universally successful. At this important moment Napoleon concluded a very advantageous peace, and thus became the hero of the hour (17 Oct. 1797).

Napoleon on the Scene.— The incompetency of the Directory resulted in another combination of European powers against it, including England, Russia, Austria, Germany, Turkey, Naples, Piedmont and the Barbary States; and the French government was forced to resort to conscription to obtain an army with which to meet the threatened danger. The wonderful successes of the comparatively weak forces of France against this strong coalition managed to keep alive the Directory but did not in any way help it to mend its ways, which had long ago become hopeless. The return of Napoleon to France in 1799 turned all eyes toward him as the coming savior of the nation. On 9 Nov. 1799, the Council of the Ancients ordered the removal of the two consuls, confiding the task to Bonaparte; and on the following day he cleared the Hall of the 500 who protested against his action; and from that moment he was dictator of France.

Bibliography.—Aulard, 'Histoire politique de la Révolution Française' (Paris 1901); 'Le culte de la Raison et le culte de l'Etre suprême' (Paris 1892); Bearn, 'Four Fascinating French Women' (London 1910); Bourgoing, 'Histoire diplomatique de l'Europe pendant la Révolution Française'; Box, 'Story of the French Revolution' (London 1907); Castle, 'French Revolution' (London 1910); Chevalier, 'Histoire de la marine française sous la première République' (Paris 1889); Chuquet, 'Les Guerres de la République' (11 vols., Paris 1886–95); Gible, 'Men and Women of the French Revolution' (Philadelphia 1906); Iung, 'L'armée de la République' (2 vols., Paris 1884); 'Bonaparte et son temps' (3 vols., Paris 1880–85); Johnston, R. M., 'The French Republic' (New York 1909); Jomeni, 'Histoire critique et militaire des campagnes de la République de 1792–1801' (15 vols., Paris 1809–24); Kropotkin, P. A., 'La Grande République' (Paris 1909); Mahan, 'Influence of Sea Power upon the French Republic and Empire' (2 vols., Boston 1892); Marty, 'La dernière année de Marie Antoinette' (Paris 1907); Michelet, 'Histoire de la République Française' (Paris 1847–53); Mignet, 'Histoire de la République Française' (Paris 1824); Morse-Stephens, 'Europe 1789–1815' (New York 1893); Mortimer-Ternaux, 'Histoire de la terreur' (8 vols., Paris 1862–81); 'History of the French Revolution' (2 vols., New York 1886); Quinet, 'La Revolution' (Paris 1878–85); Rose, 'Revolutionary and Napoleonic Era' (New York 1897); Sorrell, 'L'Europe de la Révolution Française' (8 vols., Paris 1885–92); Sarolea, 'The French Revolution and the Russian Revolution' (Edinburgh 1896); Sciolet, 'Le Directoire' (2 vols., Paris 1895); Sybel, 'Geschichte der Revolutionzeit von 1789 bis 1800' (Düsseldorf 1853–74); Thiers, 'Histoire de la Révolution Française' (Paris 1823–27); Walon, 'Histoire du tribunal revolutionnaire de Paris' (6 vols., Paris 1880–82); Warwick, 'Danton and the French Revolution' (Philadelphia 1908).

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FRENCH REVOLUTION, The. Everyone knows the story how the manuscript of the first book of Carlyle's masterpiece, 'The French Revolution,' was lost. He lent it to his friend, John Stuart Mill, who in turn lent it to his Egeria, Mrs. Taylor; and Mrs. Taylor's housemaid used it to light the fires with. But everyone does not know how Carlyle took the loss. Mill and Mrs. Taylor went together to tell him the news. It was a long and painful interview, for Mill most injudiciously stayed talking for three hours. All through the ordeal, Carlyle's whole endeavor was to relieve Mill's distress at having caused such an irreparable loss. His own distress came later when the visitor was gone. The «ill-bred Scotch collie-dog,» as he had been called, played the part of a very chivalrous gentleman. No Chesterfield could have done more. Then, consoled by his admirable wife, he sat down and rewrote the whole book, a marvelous feat of memory and determination.

The completed work has been called drama rather than history; and the usual advice to the tiro is to read some plain forthright narrative of the events of the Revolution before attacking Carlyle's version; but a very bare outline will suffice. If the reader but surrender himself to the poet-historian's dramatic method and rouse his mind to co-operate, he will come to know this period as he can know no other; for Carlyle will make him live in the heart of it. This most artistic of all Carlyle's works is cast on the lines of a great tragedy with a definite beginning, middle and end. The curtain rises on the room where Louis the Well-beloved is dying of smallpox, and falls on the streets of Paris cleared of the Revolution by Napoleon's «whiff of grape-shot.» The central catastrophe is the violent death of the false, effete, bankrupt *ancien régime*. Carlyle realizes the events himself so strongly that he almost persuades the reader he is a living witness of the scenes portrayed. Urged by hunger, the women of Paris stream out in long procession to Versailles and bring the royal family back with them, «the baker, the baker's wife, and the baker's little boy,» as they call them; for the people still have faith in their king's power to relieve their distress. At the time, it seems no more than another bread-riot. The reader is not conscious of the implications or consequences of this act, just like any observant Parisian of the time. But events march swiftly on; the net of fate tightens around the luckless king and queen; they become prisoners; they must stand trial; they must set their heads under the axe of the guillotine. Equally vivid is his portraiture of the actors in the great drama, Mirabeau, Danton, Robespierre, Marat, for Carlyle possessed what his friend Emerson called «portrait-seeing, portrait-painting eyes,» which were as effective in dealing with the past as with the actually visible present.

Carlyle's own account of its composition is the best criticism. «It all stands pretty fair in my head, nor do I mean to investigate much more about it, but to splash down what I know in large masses of colours, that it may look like a smoke-and-flame conflagration in the distance, which it is.» When he had completed the manuscript in January 1837, he wrote to Sterling: «It is a wild savage book, itself a kind of French Revolution . . . it has come hot out of my own soul, born in blackness, whirlwind and sorrow.» These remarks are illuminating. All history is interpretation of events; and the interpretation is conditioned by the historian's training, outlook, opportunities, political and religious views, even when he does not try to make history fit a theory. Other histories of the Revolution, such as Taine's, are stronger in analysis of the origins and causes of this cataclysm; but Carlyle succeeds in giving back the actual impression the Revolution made upon the world at the time, the impression of storm and earthquake, volcano and eclipse. Nor must it be inferred that his work was superficial. It was based on "indefatigable investigations," pursued with a rare love of truth. Modern criticism may gnaw at slight defects, but it cannot impugn the solidity of this great book. Traill says that it has made this terrible drama of a foreign people as real to many English readers as any passage in English history delineated by Shakespeare or by Scott.

"This book gave Carlyle at a single step his unique position as a man of letters," says Carlyle's friend and biographer. It established his reputation as a man of extraordinary gifts among the greatest of the time. Dickens carried a copy of it with him wherever he went. From it he derived the inspiration for 'A Tale of Two Cities.' Southey read and reread it six different times. Thackeray welcomed it in an enthusiastic review. Even Jeffrey, an outspoken critic of the old school, admitted its success in the teeth of all the rules and precedents.

Dr. J. Holland Rose, the learned authority on Napoleon, has produced an annotated edition of 'The French Revolution'; but perhaps the most illuminating aid to the understanding of this masterpiece is Mr. Edmund J. Sullivan's graphic interpretation of the text in a remarkable series of symbolic designs for the two-volume edition of Chapman and Hall, 1910. The genius of Carlyle is matched by the art of this master of black and white.

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FRENCH RIVER, Canada, stream in Ontario. It drains Lake Nipissing and empties into the Georgian Bay of Lake Huron after a course of 55 miles. For 150 years it was the regular route to the upper lakes, and is noted for its magnificent scenery.

FRENCH SCHOOL OF FORTIFICATIONS. See FORTIFICATIONS.

FRENCH SHORE. See NEWFOUNDLAND.

FRENCH SOMALILAND. French Somaliland is situated on the east coast of Africa to the north and the south of the Bab-el-Mandeb straits; it is bounded at the north by the Ras-Doumeirah, which separates it from the Italian possessions, at the south by a line running from the Haadou wells to Gueldeissa, which separates it from British Somaliland, and on the west by Abyssinia. The French first settled in Obock in 1858, following a voyage undertaken by M. Henri Lambert, French consular agent at Aden, to Zeilah and the Bay of Tadjourah to purchase a port at the entrance to the Red Sea in anticipation of the opening of the Suez Canal. Ibrahim Abou-Becker, one of the principal chiefs of the country, whom he rescued from the Sultan Hodeidhah's prison during this voyage, offered, as a recompense for this service, to cede to France the territories of Obock. Unfortunately M. Henri Lambert was murdered near the Mushah Isles on 4 June 1859, and his work was only taken up again two years later by Capt. Fleuriot de Langle. This officer entered into negotiations with Ibrahim Abou Becker, punished the murderers of Henri Lambert, and drew up the treaty of 11 March 1862 which gave France the port of Obock and the territory situated between Ras Doumeirah and Res Ali in consideration for a sum of 10,000 thalers. The early stages of the colonies were extremely modest, comprising a police station, a few native huts and an improvised jetty — this was during the first year of occupation in 1883. But little by little, thanks to the merchants, shopkeepers, native traders and the inhabitants of Obock who all helped in the effort to develop the country, there sprang up on this hitherto uncultivated and desert plateau, a little city, peopled by 4,000 to 5,000 souls, active and enthusiastic, and this city was full of vitality in 1895. It soon became evident that Djibouti, on account of its port, was best suited for navigation and was capable of linking up business relations with Abyssinia. Djibouti was accordingly officially made the capital in 1896.

Topography.— The coast is flat, dry, monotonous, formed of hardened sand cliffs with waterless rivers. In the centre is the Bay of Tadjourah with the port of Obock which is merely a hamlet of a few hundred inhabitants; the small station of Tadjourah, the watering stations of Amabo and Sagallo to the north of the bay, and Djibouti at the south. In the interior, up to a line parallel to the coast and distant about 90 kilometers (61 miles), where the French hinterland finishes, small plateaux are found, and farther on is an undulating country with hills leading to the heights of Harrar and between which is the Aouache.

Climate.— The climate is of an extreme dryness (not however unhealthful); sunstroke only is to be feared, but it is easy to take precautions against it. Thanks to the railway, it is possible to go from Djibouti to Diré-Daoua in eight hours, thus enabling the inhabitants to get a breath of fresh air and take a few days rest at Diré-Daoua or Harrar, which really constitute for the inland a natural sanatorium.

The inhabitants belong to two distinct races: the red African race (Danakils or Somalis) and the white Ethiopian race (Gallas). Somaliland will never be an agricultural producing country as vegetation is practically nil with the exception of a few European vegetables, some date and coconut plantations and fruit trees; it is merely a trading centre and the natural route for transportation from southern Abyssinia. A few industries have been established in Djibouti, but it is trade alone which must make the fortune of this French colony on the Red Sea. The most important product is coffee which grows in a wild state in Abyssinia and Moka, these being but a short distance from the Arabian coast. After coffee there is the ivory trade, civet, sheepskin, goatskin, oxhide, raw animal wax and gold dust. Trade on the Somaliland coast, that is at Djibouti which has practically the monopoly, amounted in 1913 to 81,620,991 francs ($16,324,198), of which 33,916,843 francs ($6,783,368) were imports and 47,704,148 francs ($9,540,809) exports. The figures for 1916 were 80,864,011 francs ($16,172,802), being made up of 39,238,856 francs ($7,847,771) for imports and 41,625,155 francs ($8,325,031) exports. It is the trade done in Abyssinia which alone keeps business going in Somaliland. Products from abroad or destined for abroad account for three-fourths. Four-fifths of this trade is however carried on under the French flag, because on the one hand the large French ships alone touch at Djibouti and on the other hand coasting between Aden and Djibouti is carried on exclusively by the French.

The territory of Cheil-Said should also be mentioned. Here merchants from Marseilles established a coal depot in 1868. The position, which has an area of 150,000 hectares (446,000 acres), is a good one from a maritime point of view as it dominates the Strait of Bab-el-Mandeb.

FRENCH SPOLIATION CLAIMS. During the great European wars from 1793 on, French privateers assailed neutral commerce, of which the American was chief, under various pretexts or without any; one was that the United States had violated the treaty of 1778. In the virtual French-American war of 1798–99, their privateers about the West Indies and elsewhere made prize of a great quantity of American shipping, for which our commissioners vainly endeavored to obtain indemnification. Finally, in the treaty of 30 Sept. 1800, as there was no hope of getting the money from Napoleon, the United States for other considerations waived the claim. From then on, even though the cases were referred in 1885 to the Court of Claims, nearly every year saw a bill before Congress to pay these claims, and at various times a vote for it was obtained, which was vetoed by the President in each case — Polk, Pierce and Cleveland. The court finally adjudicated several thousand claims, and awarded some $4,800,000. Consult Carnegie Endowment for International Peace, Division of International Law, Pamphlet No. 25, 'Opinions of the Attorneys-General and Judgments of the Supreme Court and Court of Claims of the United States Relating to the Controversy Over Neutral Rights between the United States and France' (Washington 1917); id., Pamphlet No. 24, 'Documents Relating to the Controversy over Neutral Rights between the United States and France, 1797–1800' (Washington 1917); United States, Senate, Claims Committee, 'French Spoliations, etc.' (Washington 1912); United States, War Claims Committee (House), 'Veto Messages of J. K. Polk, F. Pierce and G. Cleveland of French Spoliation Claims' (Washington 1912).

FRENCH SUDAN, Africa, the name formerly given to a large tract of country in the western Sudan, including the upper basin of the Senegal and the countries watered by the Upper and Middle Niger; bounded on the west by Senegal, on the south partly by the French territory of Rivières du Sud, and on the east by independent tribes and by British territory. Officially it was divided into "annexed territories," mostly in the western part, and protectorates. The entire region now forms a part of the Government General of French West Africa.

FRENCH TAPESTRY. See TAPESTRIES.

FRENCH WEST AFRICA. A French government-general comprising the colonies of Senegal, French Guinea, the Ivory Coast, Dahomey, Upper Senegal-Niger. From the Rio de Oro to English Nigeria, the West African colonies are scattered over the west coast of Africa, separated from each other by various foreign colonies. For instance, Casamanca is separated from Senegal by English Gambia, and between Casamanca and French Guinea we find Portuguese Guinea. Then there is Sierra Leone and Liberia between French Guinea and the Ivory Coast which itself is separated from Dahomey by the Gold Coast and Togo. Yet although the French colonies from the Rio de Oro to Nigeria do not form an uninterrupted territory, they none the less possess an advantage over certain other foreign possessions which are completely enclosed, in that every one is within the loop formed by the Niger and has access to the common hinterland where all meet. It was at the commencement of the 14th century that the west coast of Africa began to be explored and colonized by the French. In 1365 some Dieppe sailors settled on the Senegal and Sierra Leone coasts; the first establishments, founded at great expense, soon disappeared with the exception of Senegal. Richelieu by forming colonization companies, gave a new development to these possessions and such companies administered Senegal, under different names, until 1758, when the colony fell into the hands of the English.

Retaken in 1779 by the Duke of Lauzun, Senegal was thereafter governed by agents appointed by the king. The capitulation of 14 July 1809 again placed the colony under English control, but it was restored to France in 1817. Up to 1855, however, France merely occupied different points on the coast. After the disastrous Franco-Prussian War of 1870–71, French public opinion was not properly informed as to the value of French West Africa, and, consequently, was not particularly imbued with the idea of expansion in these latitudes. Colonel Faidherbe's exploits and the progress made by French domination in the Saharean Oasis regions, gave food for reflection as to the advantages to be gained, from a political and commercial aspect, by reaching the Niger, despite the bad impression caused through the unfortunate expeditions of Mungo-Park and Lander. Faidherbe, moreover, was popular on account of the services he had rendered in the country's defense and his victories in Africa. But whilst the time was ripe for French explorations and conquests in Africa, the objective changed on several occasions. At first, the only desire was to extend beyond the Valley of Senegal into the Valley of the Niger; then came the feverish attraction of the wonderful Sudan which, conquered during the early campaigns in its northern part and henceforth illustrious with the names of Galliéni and Borgnis-Desbordes, excited no less public enthusiasm despite some crying disappointments. Then the view from the valley of the Niger and the more meridional regions, better watered, better cultivated and peopled, modified first impressions and took attention away from the tracts of land nearest to Upper Senegal. Finally the riches of Guinea, Fouta-Djallon, the Ivory Coast and Dahomey, became known, and the spirit of conquest and civilization could now speculate on these countries so varied and different in aspect.

Shortly afterward, Captain Binger showed up the empty hypotheses concerning the Kong Heights and, removing the prejudice which gave to the Ivory Coast colonies and Dahomey the petty importance of coaling stations without distant relations with the hinterland, proved in 1887–89 that there were as many «doors to the Sudan» as France possessed territory on the West African coast, from the mouths of the Senegal to those of the Niger; and the absolute necessity of joining up the whole of the Sudan, the Senegal and the Niger, the rivers at the south and the Guinea coast became obvious. From 1890 to 1901 (a period fertile in good results) a logical plan for colonial expansion was methodically carried out. In Senegal, Guinea, the Ivory Coast, and later in Dahomey, successful efforts were also made for territorial expansion, similar care being taken to draw the rich products of the hinterland toward the ports. Hereafter no doubt could remain concerning the economical future of the recently acquired colonies. The future of the Ivory Coast hinterland was no longer uncertain since the capture of Samory by Captain Gouraud on 29 Sept. 1898, following on the campaigns of Colonel Archinard. Since the two expeditions resulting in the defeat of Behanzin (1892–94) and since the settlement of the latent conflict between Great Britain and France regarding the borders of Lower Nigeria and Dahomey, the commercial future of the old kingdom of Dahomey could be unreservedly considered. The Brosselard-Faidherbe, Madrolle and Paroisse missions had proved as regards the Fouta-Djallon the importance of a commercial route terminating at Conakry. Certain missions excellently carried out across the Sahara resulted in the linking up of extreme South Algeria with the Kongo on the one side and French Sudan on the other.

While explorers traveled over the new regions, signing treaties with the native chiefs, and officers occupied (sometimes peaceably, sometimes by force of arms) territory which later on was to form French West Africa, French diplomacy did not remain passive, but turned these efforts to account to get the European Powers to recognize the countries placed under French influence. The Franco-English treaties of 10 Aug. 1889, 5 Aug. 1890, 25 Jan. 1895, 14 June 1898 and 8 April 1904, were completed by fixing frontier boundaries in agreement with Spain (27 June 1900), Germany (24 Dec. 1885 and 23 July 1897), Portugal (12 May 1886) and Liberia (8 Dec. 1892 and 18 Sept. 1907). Hereafter from the south of Morocco and Algeria to the Tchad «West Africa» was master of its own destinies. Very soon, however, the progress of French developments in Sudan obliged France to take steps to repress the troubles fomented by the Moors in the territory on the right bank of the Senegal. The progressive occupation, which it was desired to carry out in a spirit of pacificism, of the regions covered by the treaties of zones of influence was decided upon; the Moors, however, were hostile to the organization of Mauretania and numerous incidents took place such as the murder of Coppolani, the government's commissioner, in May 1905 and the Akjoucht fighting. But whatever might be the extent of these disturbances and however painful the unforeseen consequences sometimes are, regional troubles are always bound to arise, which, however, by their very nature are easy to localize, if not so easy to repress, and it is not necessary to have recourse to those punitive expeditions of which Continental France, moreover, has never had the monopoly. From a geographical point of view, the aspect of the coasts of French West Africa is very varied: the coasts are bordered with sand banks against which the waves break from Cape Blanc to the estuary of the Casamanca; rocky and much cut up in Guinea; bordered with lagoons on the Ivory Coast and at Dahomey. French West Africa is relatively flat; the mountainous region is situated in Guinea and extends from the Fouta-Djallon to the Kong country: this is the most salubrious part of the colony. West Africa is divided into two quite distinct river basins: the Senegal and the Niger, both of which have their source in the Fouta-Djallon and follow for some distance the same direction, the former toward Cape Vert where it flows into the sea after joining the Falémé and the Baoulé and watering Kayes, Bakel, Matam, Salde, Podor and Dagana,— the Niger flows toward the end of the Gulf of Guinea which it reaches after describing a wide curve on which are situated Toulimandio, Koulikoro, Segousikoro, Sansanding, Mopte and Kabara, one of the three ports of Timbuktoo.

The ethnography of West Africa is as yet difficult to determine in a scientific manner; the type of white man we find there comprise the Berbers, who live in the desert zone and are called Touareg in the Sahara; there is a red African type composed mostly of Feulhs or Foullenes from Senegambia, distant cousins of the Egyptian «fellahs,» which is a mixture of the African negro type and the Berbers; finally, there is the black type of infinite variety from the Ouolofs, from Lower Senegambia, which represent the negro type in all its purity, the Sonikès, nomads, the Mandingues, intelligent but warlike and given to pillage, to the Achantis of the Ivory Coast, Dahomenians and Haoussas of Upper Dahomey.

In organizing the immense territories which the valor of her explorers and the efforts of her politicians had assured for France, it seems evident that the fascination of empty words and the superstition of formulæ were not allowed to prevail; it would have been regrettable not to have resisted any such temptation when dealing with populations so greatly dissimilar as those of West Africa. When, in 1899, it was proposed to establish an embryonic organization in what was later to be known as The Guinea, The Ivory Coast and Dahomey, it appeared necessary to separate them administratively from The Senegal to which they had been hitherto connected under the name of «Southern Rivers and Dependencies.» But very shortly the mutual interests of the local governments became evident and a decree of 16 June 1895, which created the General Government of French West Africa, instituted a supreme authority which could, by reaching a decisive opinion on the spot, make the general interest override any particular tendencies of such and such a colony of the group. But the transformation was insufficient, as was also that effected later by decree of October 1902. It seemed an opportune moment to make a further step toward a more rational and profitable organization of the vast French West African possessions, and by a decree of 18 Oct. 1904, making the general government the instrument for the permanent direction and control of French West Africa by placing at its disposal, through the creation of a general budget, the necessary financial aid for its expenses in the common interest and to represent the civic dignity of West Africa, it was hoped that the general government would be able to develop the possessions in a normal manner.

The decree of 18 Oct. 1904 regulates the present organization of the general government. The immense territories to be controlled by the government have an extent of 3,913,250 square kilometers (1,510,795 square miles), comprising five colonies and a civil territory:—

1. Senegal, capital Saint Louis
2. Upper Senegal and Niger
3. Guinea, capital Koncary
4. Ivory Coast, capital Bingerville
5. Dahomey, capital Porto-Novo
6. Civil territory of Mauretania

The governor-general holds mandatory powers from the French Republic and his residence is at Dakar. He is assisted by a council. The colonies forming the group enjoy administrative and financial autonomy; each one is administered, under the superior authority of the governor-general, by a governor of the colonies whose title is lieutenant-governor and assisted by a secretary-general. The civil territory of Mauretania is administered by a commissioner of the governor-general of French West Africa. In the organization of West Africa, the question of improving the moral and general situation of the natives has received the constant attention of the administration. Evidence of this is found in the contracts passed between natives, in the improvement of the situation of natives, the organization of public education, the development of public hygiene and the medical aid rendered to the natives. West Africa is above all an agricultural country; it is therefore not surprising that agriculture has reached quite an advanced stage among these people so primitive in some respects. The produce of the land may be classed in two categories: agricultural products and food products, or in other words, those which are cultivated with more or less care; and the products of the forests. First among the agricultural products figure the arachide, or peanut, which has so enriched Senegal and the cultivation of which even extends to the Sudan. Practically the entire exportations of fruits and grains from Senegal to the Sudan consists of this product. If it is borne in mind that it was only about the year 1840 that this culture was started, its rapid development is seen by the export figures for the year 1913, which show, for Senegal, 229,961,605 kilogrammes (231,500 tons), for Upper Senegal and Niger, 8,577,135 kilogrammes (9,175 tons), and for Guinea 3,541,106 kilogrammes (3,714 tons).

The climate of French West Africa is suitable for producing cotton, the type of which has not yet been improved all-round, but which nevertheless can be used in the metropolitan workshops. From the results already obtained great hopes may be placed in the future of this cultivation. Upper Senegal and Niger, the Ivory Coast and Dahomey have, moreover, commenced to export a certain quantity of cotton. Dahomey exported in 1913, 171,173 kilogrammes (376,580 pounds) of cotton wool and 37,740 kilogrammes (83,028 pounds) of unseeded cotton; the Ivory Coast exported 18,221 kilogrammes (40,086 pounds) of cotton wool and Guinea 60,517 kilogrammes (133,137 pounds) of unseeded cotton. Kapok exported about 33,000 kilogrammes (72,600 pounds). The dâ grows wild in the Sudan and produces beautiful fibres. The growing of agave has several times been seriously attempted by the Europeans in Senegal.

Sorgho or large millet has been greatly cultivated in the West African colonies; it has been said, not without truth, that «millet is to Africa what rice is to Asia.» Another variety of millet is also found, the little millet or sania, or «mil chandelle» (wax millet). There is also a fairly considerable local trade in rice, cultivated more particularly in Upper Guinea, in Casamanca and in the inundated countries of the Middle Niger; there were 11,584 kilogrammes (25,485 pounds) of rice exported from Guinea in 1913. Manioc is more especially cultivated in Dahomey, the Ivory Coast and in Guinea; at the present time it is only used for local consumption, but when seriously taken up as a commercial proposition it will give considerable traffic to the railways. Sweet potatoes are found everywhere. Maize is cultivated particularly in Dahomey and locally serves as a food, but its cultivation for exportation is only carried on by the natives and therefore merits attention; the exports from Dahomey alone reached 13,256,193 kilogrammes (14,582 tons) in the year 1913.

Bananas form the principal food for the inhabitants of the Ivory Coast. Copra is exported from the Ivory Coast and Dahomey. Coffee is a product of Guinea where the «Rio Nunez,» with its rather small beans, of a dirty yellow with brilliant pellicles, is much appreciated on account of its special aroma, and on the Ivory Coast, where its export reached a figure of 10,637 kilogrammes (23,401 pounds) for 1913. The cultivation of cocoa, attempted with much success by the natives in the English colonies of the Gold Coast and Nigeria, has been developed in Dahomey and above all on the Ivory Coast which respectively exported in 1913, 10,651 kilogrammes (23,432 pounds), and 47,190 kilogrammes (103,818 pounds).

Among the principal products derived from the forests, rubber holds one of the foremost places, the territories producing it being Guinea, the Ivory Coast, the Sudan region and Casamanca. No definite choice has yet been reached as to which rubber trees should be cultivated but it would seem that the Funtumia will give good results, and accordingly the administration has taken steps, principally on the Ivory Coast, to protect this tree against a too extensive exploitation. The French markets of Bordeaux and Havre, new to this commerce, receive a fairly large quantity of African rubber, but Liverpool also receives an important supply. The exports for the year 1913 were the following: Guinea, 1,455,450 kilogrammes (3,210,990 pounds); Ivory Coast, 4,684,095 kilogrammes (10,305,009 pounds); Upper Senegal and Niger, 83,300 kilogrammes (183,260 pounds); Senegal, 90,421 kilogrammes (198,926 pounds); Dahomey, 5,105 kilogrammes (11,231 pounds).

The Ivory Coast and Dahomey are the colonies which export the greatest quantity of palmetto; this is abundant in the coastal region which is not dominated by the large forests. During the year 1913, Dahomey exported 7,971,220 kilogrammes (17,536,684 pounds) of palm oil, the Ivory Coast 6,014,460 kilogrammes (13,231,812 pounds), and Guinea 164,221 kilogrammes (361,286 pounds); for the same period Dahomey exported 26,371,438 kilogrammes (58,017,163 pounds) of palm almonds, the Ivory Coast 6,949,206 kilogrammes (15,288,253 pounds), Guinea 5,172,165 kilogrammes (11,378,763 pounds), Senegal 1,901,024 kilogrammes (4,182,252 pounds). Palm oil and palmetto are used principally in the manufacture of soap and stearine and are dispatched to Marseilles and England; a considerable quantity of these products was also sent to Germany. Ivory Coast is the richest as regards forest lands. The forests in this colony only have been most carefully explored by M. Auguste Chevalier, Directeur du Laboratoire d'Agromomie Colonial au Musée de Paris, who has made a thorough botanical classification of the different kinds of wood, and who estimates the wooded area at over 120,000 square kilometers (46,332 square miles). This area is very rich and valuable woods, the only ones which have been cultivated for many years, foremost among which is mahogany suitable for diagonal grained work and for decorative panels. Since then, many other samples have been experimented with and it now appears certain that commerce in general and the cabinet-making trade in particular will find on the Ivory Coast, the former, woods supplanting oak and teak which are lacking and of lengths and widths to which they have not been accustomed; the latter, new woods of beautiful shades which will enable satisfaction to be given to all customers' tastes. Wood exports from the Ivory Coast amounted in 1913 to 52,700 tons, representing a value of 5,000,000 francs ($1,000,000).

The kola business has been developed considerably by the natives and every day sees a more and more extensive use of it since the consumption of alcohol is no longer permitted on account of the growing prevalence of Islamitic beliefs. It is exported to Europe in ever-increasing quantities, as fresh fruit, to be consumed mostly in the form of extracts or wine tonics. In the year 1913 Dahomey exported 21,808 kilogrammes (47,977 pounds), and the Ivory Coast 24,090 kilogrammes (52,998 pounds).

Karité is found practically all over the West African possessions but principally in Upper Senegal and Niger, which, by the Kayes Railway and the river Senegal, makes large exportations of this fatty matter extracted on the spot by the natives. The exportation of kareté butter reached, in 1913, for Dahomey 169,841 kilogrammes (373,650 pounds), for Upper Senegal and Niger 27,565 kilogrammes (60,643 pounds), for the Ivory Coast 8,787 kilogrammes (19,331 pounds), and for Guinea 3,899 kilogrammes (19,331 pounds). The exportation of karité almonds from Upper Senegal and Niger, exclusively reached 474,624 kilogrammes (1,044,172 pounds).

Finally, gums, exuded by different trees of the acacia genus, are concentrated at, and dispatched from, one place, i.e., Saint Louis, from whence it is all shipped to France, the port of destination being Bordeaux. The exportation for 1913, for Senegal, amounted to 2,943,379 kilogrammes (3,238 tons), and for Upper Senegal and Niger 532,157 kilogrammes (585 tons).

Cattle breeding plays an important rôle, and is destined to play even a greater one, in the prosperity of the West African colonies. It is therefore necessary to encourage this industry in countries where labor is scarce, and with a view of procuring on the spot the necessary cattle for food for the European and the native. The principal centres are Senegal, the Sudan, Guinea and Dahomey, where horses, asses and bovidæ are found. The bovidæ are found more especially in Mauretania and Sudan Sahara. The raw skins of oxen, sheep and goat form an important exportation; in the year 1913 exports amounted to 1,010,743 kilogrammes (2,223,034 pounds) for Guinea, 802,931 kilogrammes (1,766,448 pounds) for Senegal, 211,405 kilogrammes (465,091 pounds) for Upper Senegal and Niger, and 50,333 kilogrammes (110,732 pounds) for the Ivory Coast. The trade in wool frôm Macina (Upper Senegal-Niger) is relatively recent, but it is beginning, however, to be put on a proper commercial basis, and its exportation amounts to 250,000 kilogrammes (550,000 pounds). Certain wild birds (ostriches, herons, marabouts) furnish valuable feathers. Wax is prepared in Gambia, Casamanca, Boubdou and the surroundings of Thiès and its exportation exceeded 180,000 kilogrammes (396,000 pounds) in 1913. The foregoing enumeration of the principal agricultural, forestral and animal products of French West Africa will give an idea of the variety of cultivation in the West African colonies, but although confidence can be placed in the future agricultural development of the colonies it must be recognized that no industry at present exists there in the real meaning of the word.

The West African colonies are fàr from being known from the point of view of geology and mineralogy, despite the highly scientific work of M. Hubert. The raw materials principally exploited are gold and salt. Gold is found in Upper Senegal where its production is estimated at approximately 800,000 francs ($160,000) yearly, and in Upper Guinea and the Bambouk region where gold from Falémé and Galam has been exploited since 1858 by the government. In 1913 the exportation of gold for this group of colonies amounted to 255,635 francs ($51,127). Salt is of two kinds: sea salt from the coast where the Gandiole salines constitute a fairly important output for Senegal; rock salt from the interior to the north of the town of Timbuktoo. Each year there enters into Upper Senegal-Niger, emanating from the Sahel and Sahara, an average of 80,000 bars of salt. The mining industries of this group of colonies have been the object of special legislation both as regards prospecting and operation of mines.

The fishing industry ranks next to the mineral industry. Fishing is at present practised over the entire west coast, but more particularly in Senegal and Dahomey. The coasts of Senegal and Mauretania have long ago been recognized for their ichthyological richness; the results of the efforts made to develop the fishing industry at the Lévrier Bay are now an accomplished fact; French fishermen are interested in fresh fish and the crustacea to send to France, and the dry fish for African consumption. The exportation of dry fish, salted or smoked, reached 575,354 kilogrammes (1,265,778 pounds) in 1913. But it is not merely sufficient for West Africa to be abundantly provided from an agricultural point of view and for its soil to be stocked with riches. If the commercial movement of the colony has made rapid progress and if the financial situation of French West Africa has constantly improved of late years, the cause should be looked for in the persevering efforts made by the local administration to furnish this group of colonies with the necessary economical equipment for their proper development. The ports have been improved, the railways from Daker to Saint Louis, from Thiès to Kayes, from Kayes to the Niger, have been constructed as well as the railways in Guinea, the Ivory Coast and Dahomey. It will therefore be seen that the dominating idea of the governor-general has been to open up lines of communication and to practise the policy of penetration by railways. The results have been excellent inasmuch as the general commerce, which in 1895, i.e., at the time the general government was created, amounted to 78,777,356 francs ($15,755,471), reached 10 years later 155,592,303 francs ($31,118,460). In 1913, the last normal year, the figure amounted to 277,718,152 francs ($55,543,636), made up as follows: 151,574,300 francs ($30,314,800), in importations and 126,143,852 francs ($25,228,770) exportations. The figure fell in 1914 to 233,928,780 francs ($46,785,756) and in 1915 to 225,484,917 francs ($45,096,983). For 1916 a total of 300,013,474 francs ($60,002,694) is estimated, made up as 172,137,615 francs ($34,427,523) for importations and 127,875,859 francs ($25,575,171) for exportations.

FRENCH WEST INDIES. The French West Indies form part of that stretch of volcanic islands which seem to connect North and South America. France possesses from the north to the south: the northern part of the island of Saint Martin, Saint Barthélemy, Guadeloupe and its dependencies, Désirade, Marie Galante, the Saintes Isles and Martinique. Martinique and Guadeloupe — the two sister islands — hold the foremost place among the French Antilles.

Guadeloupe.— Guadeloupe was discovered by Christopher Columbus who, while making a second exploring expedition in the Atlantic, perceived on 4 Nov. 1493 an island which he named after the monks of the convent of Notre Dame de Guadeloupe in Estremadura. The island remained Spanish until 1635 when Duplessis and Olive took possession of it in the name of «la Compagnie des Iles d'Amérique.» In March 1674 the colonization companies being in straightened circumstances the islands were made part of the royal domain, but the administration of the king was interrupted from 27 April 1759 to 4 July 1763 by a first occupation by the English under the command of Admiral Moore and General Barington. On 21 April 1794, during the Revolutionary period, the island was retaken by the English, only to be recovered on 2 June following by the delegates of the National Convention, Victor Hugues and Chrétien. A third and last British occupation took place during the Wars of the Empire lasting from 1810 to 1816 when Guadeloupe was definitely restored to France.

Area and Topography, etc.— Guadeloupe, which has an area of 1,780 kilometers (583 square miles), is divided into two islands independent of each other: Guadeloupe proper or Basse Terre and Grande Terre, separated by a stretch of sea about six miles in length and of a width varying from 90 to 300 feet. Basse Terre has the form of an irregular ellipse; it possesses many signs of its original volcanic state, there being still some active volcanoes, like the Soufrière. Grande Terre is in the form of a triangle and the principal ports of the colony are found there: Pointe à Pitre, Moule, Saint François, Sainte Anne and Port Louis. There are three districts in the island: Basse Terre, Pointe à Pitre and Marie Galante. During winter, Guadeloupe is subject to severe atmospheric perturbations and is frequently disturbed by cyclones in August and September.

Commerce.— In order to form a correct idea of the traffic movements in the principal products exported, we must take the figures for a normal year and not one which has suffered from the war (the 1914 and 1915 returns amounted to 43,728,540 francs ($8,745,708) and 46,323,164 francs ($9,264,632) respectively). Moreover, it is not fair to take a year like 1913 when atmospheric conditions were very unfavorable — 38,462,419 francs ($7,692,483). We will therefore take the year 1912 which may be considered as normal; the commercial movement amounted to 45,608,418 francs ($9,121,683), made up of 19,524,116 francs ($3,904,823) imports and 26,084,302 francs ($5,216,860) exports. Sugar-cane products hold the foremost place. The production of cane sugar has reached 39,000 tons, representing a value of 16,660,000 francs ($3,332,000 annually); the planters at present concentrate their efforts on better varieties and pay more attention to the extracting processes. The molasses exported in 1912 amounted to 714,000 litres (188,638 United States gallons) of a value of 103,000 francs ($20,600). Rum is exported to an amount of 9,697,000 litres (2,162,740 gallons) representing a value of 4,155,000 francs ($81,000). Coffee is grown more particularly in the middle region, having an altitude of over 600 feet; the kind cultivated is the Arabian coffee or «Le Liberia,» which at the best is used for grafting. The colony exported 1,108 tons of coffee of a value of 2,605,000 francs ($521,000) in 1912. The cultivation of cocoa has been continually on the increase during the last 20 years, the export figure for 1912 being 925 tons valued at 1,400,000 francs ($280,000). Vanilla and vanilla products, cultivated more especially in Basse Terre, varies from one year to another; in 1912, 25 tons valued at 396,000 francs ($79,200), in 1913, 20 tons, in 1914, 11 tons, representing a value of 220,000 francs ($44,000). The fruit trade is making progress, although this still leaves something to be desired; the principal fruits exported are bananas (12,800 kgs., 28,160 lbs.), pineapples (156,077 kgs., 343,369 lbs.), coconuts (26,000 kgs., 57,200 lbs.). Commerce in dye-producing plants is declining. Rocou is exported to an amount of 43 tons representing a value of 17,290 francs ($3,458) as against 88 tons in 1910 of a value of 63,000 francs ($12,600). Wood for cabinet making is exported to an amount of 24 tons valued at 5,500 francs ($1,100).

Bulky foods (yams, potatoes, carribee cabbages, etc.) are practically all used for local consumption. The administration has decided to encourage new cultures, principally the growth of coconuts and lemons, as much to provide against inconveniences caused by dependence on a single crop as to develop the resources of the colony. In normal times France receives nine-tenths of the production of the lands of the colony.

The dependencies of Guadeloupe include: Désirade, a rock of little productive capacity; Marie Galante with Grand Bourg, a fairly safe anchoring ground; the Saintes Archipelago, a mass of rocks which have been given the name of "The Gibraltar of the West Indies" on account of their high strategical importance; Saint Barthélemy and Saint Martin, of which France possesses two-thirds: Saint François, Sainte Anne and Port Louis.

Martinique.— Martinique was discovered by Christopher Columbus on Saint Martin's Day. The Spaniards did not settle there and the natives remained in possession of the island until 1625. At this time Pierre Belain of Esnambuc, while returning from a cruise in the Gulf of Mexico, obtained from Cardinal de Richelieu authority to constitute the "Compagnie des Iles d'Amérique; on his return to Saint Christopher he endeavored to colonize the neighboring islands and landed at Martinique on 1 Sept. 1635. In 1650 the Compagnie des Iles d'Amérique sold its islands for £60,000 to Duparquet who became their lord and master. On his death, war broke out between the French and the Caribs, which ended in the extermination of the latter. In 1664 the Crown purchased the islands from the heirs of Duparquet and ceded its rights to the Compagnie des Indes Occidentales. During the succeeding years, Martinique was attacked by the English and the Dutch, which resulted in the dissolution of the Compagnie and the return of the islands to the Crown. Cultivation was undertaken but very soon Martinique had other serious preoccupations and for more than a century was obliged to defend herself against the furious onslaughts of her enemies. In 1762 the island fell into the hands of the English who restored it to France one year later on the signing of the Treaty of Paris, but at the price of the loss of Canada. In 1793 the Royalist party surrendered the island to the English who kept it until the Peace of Amiens was signed. The English reoccupied it during the Empire Wars of 1808–14 and finally during the "Hundred Days." Since the treaty of 20 Nov. 1815 Martinique has always remained French and after the abolition of slavery in 1848, by a number of laws — not affecting however its colonial life — it has participated more and more in the public life of the mother country as one of her possessions.

Martinique which has an area of 987 square kilometers (385 square miles), the greatest length of which is 70 kilometers (44 miles) and the average width 31 kilometers (20 miles), is divided into two parts — two peninsulas united by the isthmus which is situated between the "cul de sac" of François and the "cul de sac" of Fort-de-France. Its mountain range really consists of two high peaks, one in the north and one in the south, connected by a small chain of mountains much less in height. All these mountains, which bear the name of "peaks" or "knolls" are of volcanic origin and we need scarcely recall here the awful calamity caused by the eruption of Mount Pelée in September 1907 which completely devastated the southern part of the island. Cyclones similar in character to those which play such havoc with the other West Indian islands do not spare Martinique and they are generally accompanied by a tidal-wave.

From a political point of view, Martinique is divided into two districts, the capitals of which were until 1902 Fort-de-France and Saint Pierre.

Commerce, Trade, etc.— Exportations amounted in 1913 to 28,896,814 francs ($5,779,362) out of a total trade of 51,041,129 francs ($10,208,225). In this total products from the land figure to an amount of 25,900,000 francs ($5,180,000). Sugar-cane is the principal crop of the island, the exportation for 1913 amounting to 40,000 tons, which is slightly higher than that of 1912. The exportation of rum, which occupies the second place in the trade of the island, amounted in value to about 7,000,000 francs ($1,400,000) in 1912, rising in 1913 to 12,000,000 francs ($2,400,000) for 18,823,000 litres (4,973,026 United States gallons). Next in importance is the cultivation of cocoa which is exported in berries to an amount of 524 tons of a value of 1,071,000 francs ($214,200). Coffee beans are exported to the amount of 9,587 kilogrammes (21,091 pounds), valued at 23,932 francs ($4,786). Vanilla figures for an exportation of 3,259 kilogrammes (7,169 pounds), representing 76,373 francs ($15,274); cinnamon 1,875 kilogrammes (4,125 pounds), valued at 1,234 francs ($246). The fresh-fruit trade has not yet attained that importance of which it is capable (40,675 francs, $8,135); the principal fruits exported being bananas (10,000 francs, $2,000); pineapples (15,000 francs, $3,000) and oranges (1,400 francs, $280). Oil from Indian wood is a fairly active industry, the results for 1913 being 2,649 kilos (5,827 pounds), representing a value of 23,495 francs ($4,699). In the category of farinaceous products, fecula and potatoes show exportations of 11 and 77 tons, respectively. The manufacture of citrate of lime is no longer in the experimental stage and the results obtained are highly satisfactory, the exportation amounting to 2,000 kilogrammes (4,400 pounds). All the citrate is shipped to England.

France accounted for 51.4 per cent of the trade movement in Martinique in importations, and 93 per cent in exportations; business with other countries amounts to 46.08 per cent and 3.78 per cent of the importations and of the exportations, respectively.

FRENCHMAN'S BAY, Maine, an ocean inlet in Hancock County, extending northward about 30 miles with a width of about five miles. It contains a number of islands, among them Mount Desert, whereon is situated Bar Harbor (q.v.).

FRENCHTOWN, Md., in the War of 1812. As part of the British operations on Chesapeake Bay in 1813, Sir George Cockburn was sent to close its head. Establishing himself first at the mouth of the Susquehanna, then on Elk River, on 28 April he sent 150 marines to destroy the stores at Frenchtown, a small village much used in the land transport between Baltimore and Philadelphia since the closure of the bay. They drove off the Americans and burned the stores and five vessels lying near.

FRENCHTOWN, Mich., Battle of, in the War of 1812. Hull's surrender of Detroit threw the American frontier back to the line of the Wabash and the Maumee. The Maumee was defended by Fort Wayne, about 20 miles from the Ohio border, and the Wabash by Fort Harrison, a block-house standing near the site of the present city of Terre Haute, near the Illinois border. In September 1812, after the departure of Sir Isaac Brock (q.v.) for Niagara, these forts were attacked simultaneously by the Indians, but Zachary Taylor saved Fort Stephenson and Fort Wayne held out until reinforcements arrived on 12 September under Gen. W. H. Harrison. The latter then divided his troops into three bodies to march by different routes to the Maumee Rapids, one of which forces, under Gen. James Winchester, after experiencing great hardships, reached the rapids 10 Jan. 1813, and there began to encamp. Two Frenchmen came to beg protection for Frenchtown, Mich., a little village on the Raisin River, about 30 miles to the north and 22 miles southwest of Detroit. Winchester sent half his troops who, on 18 January, with small loss, drove the British and Indians from the town, which success so elated the troops left behind at the Maumee that Winchester led them to the town, encamping there on 20 January but failing to take the usual military defensive measures. On the 21st the British commander, Gen. Henry Proctor, started toward the town with a force of 600 militia and 500 Indians under Round Head, making the assault on the American position the next day. Most of the American troops were in the open field and quickly succumbed, Winchester being among the captured. But a small body of Americans stoutly resisted behind a picket defense until Winchester, under Proctor's threat of burning the village and an Indian massacre, ordered them to surrender. The unwounded prisoners were sent to Malden but the wounded were left at Frenchtown under Proctor's promise of adequate protection. But Proctor failed to furnish protection and after his departure the Indians plundered the village, mutilated and scalped the dead, stripped the inhabitants of clothing and valuables and fired the houses, consuming the injured and the dead. The American loss was 934 killed, captured and massacred; the British loss was 24 killed and 158 wounded.

Had Proctor advanced to the Maumee Rapids he might have captured Harrison with his 900 troops and their artillery and stores. But Harrison burned the post and retreated to the Portage or Carrying River, about 18 miles to the rear, where on 1 Feb. 1813 he began the construction of Fort Meigs, before which on 28 April Proctor appeared with 983 regulars and militia and 1,200 Indians under Tecumseh (q.v.). On 1 May the British began the bombardment which lasted several days, but on 5 May were attacked on the north side of the river by a force under Brig.-Gen. Green Clay (q.v.) who had come to Harrison's relief. This force was almost annihilated by the British, but Harrison made a successful sortie on the south side. The siege was continued for several days but Proctor's army was weakened by death and sickness and by the desertion of the Indians, and on 9 May he retreated to Malden unmolested by Harrison. On 20 July Proctor again attacked the fort but after vainly trying to draw Clay into ambush decided to attack Harrison at Seneca on the Upper Sandusky, whither the latter had moved his magazine. Between Harrison's troops and the British was a stockade called Fort Stephenson, defended by one cannon and 160 troops under Maj. George Croghan (q.v.). Harrison ordered the evacuation of the fort but Croghan refused, and when the British attacked on 1–2 August not only repulsed them but inflicted such a decisive defeat that Proctor retreated to Malden. The British loss was 26 killed, 41 wounded and 30 missing, while Croghan lost only one killed and seven wounded. Soon afterward Tecumseh raised the siege of Fort Meigs and followed Proctor to Detroit. Harrison remained at Seneca until September, when he began the march that brought about the battle of the Thames (q.v.). Consult Wiley and Rines, 'The United States' (Vol. V, pp. 361–372, giving extensive bibliography); Adams, Henry, 'Administrations of Jefferson and Madison' (Vol. VII, pp. 72–115); histories of the war by Brackenridge, Lossing, Armstrong, McAfee, Richardson, Auchinleck, Perkins, etc.; Edwards, 'History of Illinois' and 'Life and Times of Ninian Edwards'; Montgomery, Henry, 'Life of Harrison'; Slocum, 'The Ohio Country'; Shaler, N. S., 'Kentucky'; Brown, S. R., 'Campaigns of the Northwestern Army'; Dawson, Moses, 'Life of Harrison'; Brannan, 'Official Letters'; McMullen, 'History of Canada'; James, William, 'Military Occurrences'; Fay, H. A., 'Official Accounts'; Knapp, 'The Maumee Valley'; Williams, Samuel, 'Two Western Campaigns in the War of 1812'; Dawson, 'Battles of the United States'; Cooley, T. M., 'Michigan'; Everett, 'History of Sandusky County'; Howe, 'Historical Collections of Ohio'; Atwater, Caleb, 'History of Ohio.'

FREND, William, English reformer: b. Canterbury, 1757; d. 1841. He was educated at Saint Omer, France, and at Cambridge University. In 1781 he was chosen Fellow and became rector of Madingley in 1783. He was converted to Unitarianism in 1787, when he issued his 'Address to the Inhabitants of Cambridge to turn from the False Worship of Three Persons to the Worship of the One True God' (1788). About 1790 he traveled abroad and on his return published the radical pamphlet 'Peace and Union Recommended to the Associated Bodies of Republicans and Anti-Republicans,' which led to his trial and conviction for breaking the Statute *De Concionibus*. He was banished from Cambridge but remained a Fellow of the university until his marriage in 1808. From 1806 to 1826 he was connected with the Rock Life Assurance Company. He was active in every radical and popular movement of his time. He wrote, in addition to those mentioned above, 'Thoughts on Religious Texts' (1789); 'An Account of the Proceedings in the University of Cambridge against William Frend' (1793); 'Scarcity of Bread' (1795); 'A Letter to the Vice-Chancellor of Cambridge' (1798); 'Principles of Taxation' (1799); 'The Effect of

Paper Money on the Price of Provisions' (1801); 'Letter on the Slave Trade' (1817).

FRENEAU, frę'nō, **Philip**, American poet: b. New York, 2 Jan. 1752; d. near Freehold, N. J., 18 Dec. 1832. Graduated from Princeton in 1771, he was captured in 1780, during a voyage to the West Indies, by an English cruiser, and his experiences while under detention he later recorded in 'The British Prison-Ship.' Having regained his liberty, he wrote much for the *Freeman's Journal* of Philadelphia. In 1790 he became editor of the *Daily Advertiser* (New York), and in 1791 of the *National Gazette* (Philadelphia). After an interval at sea he permanently settled in New Jersey. Freneau was the first national poet of America and a lyrist of real though uneven gifts. His elegy, 'The Battle of Eutaw Springs,' was praised by Scott, who called it "as fine a thing of the kind as there is in the language." During the Revolution he was active in satirical verse. His work attests his extensive culture; and though it conforms in the main to the conventions of the 18th century, it does not lack distinction. He wrote also several volumes of prose, published under the pseudonym "Robert Slender" and of small merit. Until recently his poetry has been strangely neglected; but in 1901 appeared a biography by Austin, and in 1903 an edition of the poems, with a 'Life,' prepared by F. L. Pattee. During Freneau's life there were editions in 1786, 1788, 1809 and 1815. There were reprints of the 1786 edition in 1861 and 1865. Consult further, De Lancey, E. F., 'Philip Freneau; the Huguenot Patriot Poet of the Revolution' (New York 1891); Forman, S. E., 'Political Activities of Philip Freneau' (Baltimore 1902); More, P. E., 'Shelburne Essays' (New York 1908); Paltsits, 'Bibliography of the Works of Freneau' (ib. 1903); Tyler, 'Literary History of the American Revolution' (1897); and Wendell, 'Literary History of America' (1900).

FRENSSEN, Gustav, German novelist: b. in Barlt, in Ditmarschen, a district on the western coast of Holstein, 19 Oct. 1863. He received his early education in the volksschule at Barlt and later attended the gymnasium at Meldorf and Husum, not far from his birthplace. From 1886 to 1890 he studied theology at the universities of Tübingen, Berlin and Kiel. In 1890 he became pastor in the village of Hemme in Ditmarschen. In 1902, after the phenomenal success of 'Jörn Uhl,' he resigned his position as pastor in order to devote himself entirely to literary labors. For a time he then resided in Meldorf, but eventually he moved to Blankenese on the Elbe, a suburb of Hamburg, where he at present resides. Frenssen's power lies in his ability to describe nature and the life of his home community. The fate of the families and the individuals of his neighborhood had interested him from his boyhood days. He knows the seas, the forests and the moors of his native Ditmarschen and describes them in a realistic way. In reading his novels one soon finds himself deeply interested in the characters that are being portrayed. One lives and feels with them, sympathizes with their sorrows and grows with them in the development of their ideals.

His first novel, 'Die Sandgräfin' (1896), shows as yet no originality. Frenssen is still working in the ordinary novelist's fashion. An improvement may be seen in 'Die drei Getreuen' (1898). We find here an attractive picture of the author's home community and its people. The causes of the social disturbances and the large emigration to America are treated. 'Jörn Uhl,' the book which made Frenssen's reputation, appeared in 1901. It gives a vivid description of the struggles of a peasant in his attempts to lift himself above the drudgery and misery of his environment and to realize his higher, better self. In spite of his misfortunes the hero is not discouraged and eventually emerges into a happier existence as an engineer. The average reader feels that it would have been more appropriate if Jörn would have been permitted to work out his salvation as a peasant, but he is carried away by the descriptive power of the author and all his doubts vanish. More than 250,000 copies of this novel have been sold, a success almost without precedent on the German book market. In 'Hilligenlei' ('Holy Land,' 1905) Frenssen wishes to show why the people have been unable to grasp the teachings of the man of Galilee. The book attempts to bring about a rebirth of religion in spirit and in truth. It is doubtful, however, whether the literary field should be made the arena for agitation and reform. The artistic elements in literature are likely to suffer in this way and in 'Hilligenlei' the difficult problems are not solved, nor are they elevated into the field of the purely artistic. The characters are true to life and are sketched in an attractive fashion, but the conclusion to this novel is even more unsatisfactory than in 'Jörn Uhl.'

In 'Peter Moors Fahrt nach Südwest' (1907) Frenssen gives a patriotic appreciation of German valor in a far-distant African colony. The story, which is based upon the reports of a military campaign, is told in a simple and artistic way. The author has freed himself in this book from his tendency to interpose reflections on life and there are no episodes to detract from the unity of action. In 'Klaus Hinrich Baas' (1909) Frenssen describes the career of a country lad who left his home and worked out a commercial career in the city of Hamburg. Klaus is without culture but is practical and worldly-wise and fights his way against opposition until he is known as a successful business man. While Jörn Uhl was an idealist and stargazer, Klaus is a coolly calculating man who depends entirely upon himself in attaining his ends. 'Der Untergang der Anna Hollman' pictures the tragedy of lust for wealth. The hero, Jan Guldt, an ardent youth, is temporarily overcome but eventually emerges strengthened in character and insistently demands justice. Frenssen has also published three small volumes of 'Dorfpredigten' (1889), village sermons, and two dramas, 'Das Heimatsfest' and 'Sönke Erichson.' In 1915 he wrote a 'Bismarck-Epós' in hexameters which, however, after much discussion, was withdrawn from the bookmarket, as it apparently failed to meet the ideas of the great chancellor held by most Germans.

Frenssen's writings show the influence of Storm, Raabe and Dickens. His novels have been widely read, not only in Germany, but also in translations in England and America. At times his writings have episodes which detract somewhat from the main theme, but they fascinate the reader and he would be loath to have them omitted. Occasionally one feels the preacher transcending the artist in Frenssen's desire to reform society, but we cannot help but admire his moral earnestness. He feels it his duty to speak the truth about life as he understands it. One of the admirers of Frenssen says that *Ehrlichkeit* is at the foundation of his great success. See JÖRN UHL. Consult 'Gustav Frenssen,' by Hans Martin Elster (1910); Bierwirth, H. C., in 'German Classics,' (Vol. XVII, New York 1914). Also the histories of German literature by R. M. Meyer and Alfred Biese.

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FRENZEL, Karl Wilhelm, German journalist and novelist: b. Berlin, 1827; d. 1913. He received his education in his native city and after 1861 was dramatic and literary critic of the *National-Zeitung*. He wrote very many historical novels dealing with French and German life. Among his works are 'Charlotte Corday' (1864); 'Watteau' (1864); 'La Pucelle' (1871); 'Lucifer, Ein Roman aus der Napoleonischen Zeit' (1873); 'Frau Venus' (2 vols., 1880); 'Schönheit' (1887); 'Warheit' (1889); 'Berliner Dramaturgie' (1882), a valuable contribution to the history of modern German drama.

FRÉRE, frār, **Charles Théodore,** French painter: b. Paris, 24 June 1815; d. there, 25 March 1888. He was a pupil of Cogniet and Roquelan, and made his first exhibit in 1834. He was present at the fall of Constantine, Algeria, in 1837, and from that time chose scenes from Eastern life. His pictures illustrating Constantine (1840–48) are among the best he painted. In 1869 he accompanied the Empress Eugénie in her voyage up the Nile, and made a sketchbook of aquarelles at her request. He painted some military pieces but scenes of Eastern life formed most of his subjects. The Metropolitan Museum, New York, has three of his canvases, 'Cairo Evening,' 'View of Jerusalem' and 'Departure from Jerusalem for Jaffa.'

FRERE, frēr, SIR **Henry Bartle Edward,** English statesman and administrator: b. Clydach, Brecknockshire, Wales, 29 March 1815; d. Wimbledon, Surrey, 29 May 1884. He was educated at Haileybury College; entered the East India Company's civil service in 1834; introduced improvements into the system of tax collection, and distinguished himself as an administrator. At the outbreak of the mutiny in 1857 he promptly seized the fortress of Multan, retained command over his own province, and was enabled to assist the neighboring provinces. From 1862–67 he was governor of Bombay. In 1859 he was created K. C. B., and in 1867 G. C. S. I. In 1872, as British commissioner, he negotiated a treaty with the sultan of Zanzibar abolishing the traffic in slaves. In 1877 he was appointed governor of the Cape, and high commissioner in South Africa, but the war which he provoked with the Zulus gave so much dissatisfaction to the Conservative government then in office that he was censured, and on the accession of the Liberals to power in 1880 he was recalled. He was the author of the 'Life of Hookham Frere' (1871), and his own 'Life' by Martineau was published in 1895.

FRERE, John Hookham, English poet, translator and diplomatist: b. London, 21 May 1769; d. Malta, 7 Jan. 1846. After a career in the diplomatic service, he produced his original 'Prospectus and Specimen of an Intended National Work . . . Relating to King Arthur and His Round Table' (1817), better known as 'The Monks and the Giants'; a literary burlesque, full of charming verse and of excellent character-drawing. It naturalized in English the *ottava rima* afterward used by Byron in 'Beppo' and 'Don Juan.' A version of a large part of Aristophanes succeeded this effort, and this work, which admirably embodies the spirit of the original, gives him a high place as a translator. Consult 'Life' by Sir Bartle Frere (1871).

FRÉRE, Pierre Edouard, brother of Charles Théodore Frère (q.v.), French painter: b. Paris, 10 Jan. 1819; d. Econen, May 1886. He studied under Paul Delaroche, and chose sentimental genre as his specialty; many of his delineations of home- and child-life are full of true and simple feeling and have been frequently reproduced. In technique he was remarkable as a colorist, and his 'Little Gourmand'; 'Curiosity'; 'Repose'; 'The Little Cook'; 'First Steps'; 'Going to School' have long been favorites in the print-shop windows. He exhibited in the Salon from 1842 to 1886, received a number of medals and was made a chevalier of the Legion of Honor in 1855. He also exhibited 28 times at the Royal Academy, London, between 1868 and 1885. Pictures by him are in museums at Bernay, Chartres, Cardiff, Glasgow, Hamburg, Melbourne, Sheffield. Consult Bacon, H., 'Edouard Frère' (in *Art Journal,* Vol. XXXVIII, p. 321, London 1886).

FRÉRE-ORBAN, frār'ôr'băn', **Hubert Joseph Walther,** Belgian statesman: b. Liége, 1812; d. 1896. He was educated at Liége and at Paris, and entered on the practice of law in the former city. His early leanings toward the Liberal party led to his controversy with the Catholic clergy. He was an advocate of free trade and of the priority of state over church authority and of secular public instruction. He was elected to the Belgian Chamber in 1847, and became Minister of Public Works; in 1848–52 he was Minister of Finance. He founded the National Bank of Belgium, and reduced postal rates. In 1857 on the return to power of the Liberals he became again Minister of Finance, and was made Prime Minister in 1868. He retired with his party in 1870 but returned in 1878 and was again Prime Minister until 1884. For the succeeding 10 years he was leader of the opposition, and lost his seat in 1894. He published 'La mainmorte et la charité' (1854); and 'Le question monétaire' (1874).

FRERE'S TRANSLATION OF ARISTOPHANES. Born in 1769, graduate of Cambridge in 1792, occupying various positions connected with the Foreign Office from 1799 to 1808, intimate friend of Canning, John Hookham Frere is among England's many remarkable examples of public men in letters. In spite of interpretations and views sometimes at variance with recent exact scholarship; in spite of — perhaps because of — an old-fashioned freedom, his version of 'The Acharnians,' 'The Knights,' 'The Birds' and 'The Frogs' of Aristophanes, made at intervals beginning as early as 1820 for his own gratification and the diversion of his friends, and published in 1839 and 1840 (best read now in the 'World's Classics,' with introduction by W. W. Merry), remains the English rendering that most perfectly reflects the substance and spirit of the great Greek comedian.

Certain principles of translation formulated by Frere in a review of Mitchell's Aristophanes (*Quarterly Review*, July 1820) help to account for the qualities of his work. They may be restated briefly as follows: The language of translation should never attract attention to itself; expressions remarkable in themselves should as far as possible be avoided. The forms of language should be translated according to the intention with which they are employed. In his representation of the vast mass of feeling, passion, interest, action and habit always and everywhere common to mankind, the translator should make use of the phrase in his own language to which habit and custom have assigned a conventional import similar to that of the corresponding ancient phrases, taking care, however, to avoid those which, from their form or other circumstances, are connected with associations belonging exclusively to modern manners. The translator should omit all local peculiarities which, however interesting as matters of curiosity to the antiquary, would have no other effect than that of distracting the attention, or diverting it from the broad general expression of character and humor which is evidently the primary object of the poet. The *text* of the original is not necessarily *the original itself*. The tone and the intended impression of the original must first be ascertained, and the translator may then expand his own sentences to a dimension capable of bearing a distinct and intelligible impress of character. Or, he may contract; for example, the well-known coarseness of Aristophanes, which was a sop to the vulgar crowd, should be represented in the modern version, which is addressed to an audience of greater refinement, in greatly modified form. Again, just as Aristophanes compensated for extravagance of plot and situation with reality of speech, so the translator should employ truthfulness of language; remembering, however, to give intentional unrealities, such as burlesque, their corresponding form. Finally, the successful translation should be free from any of those peculiarities, unintelligible to an English reader, which belong to antiquity but are in no wise characteristic of it, and which would distract the attention without affording employment for the imagination; and yet should so perfectly maintain the tone and character of antiquity, and the general spirit of the original author, as to make it impossible for any one to feel sure, without special acquaintance with the text, that a deviation from the original had taken place.

The difficulties confronting the translator of Aristophanes, who, it must be kept in mind, represents the comedy of personal satire, and is therefore honeycombed with localisms, are enormous — in the words of George Cornewall Lewis, an exacting critic who wrote in 1844, there are "the endless variety of his style and metres, the exuberance of his witty imagination, the richness and flexibility of the Attic language in which he wrote, and the perpetual by-play of allusions (often intimated merely by a pun, a metaphor, or a strange new compound) to the statesmen, poets, political events and institutions, manners and domestic history of his times." Without claiming everything either as to ability or consistency, it may be said that Frere has met these difficulties with extraordinary success, and that his success has been due to more or less faithful observance of his own principles. He is not always literally accurate, and he sometimes admits the localisms and modernisms he condemns; but he reproduces with great vividness the spirit of audacious extravagance and droll absurdity, the rippling, sparkling variety, the dash and rapidity, the brilliant flights of poetic fancy, which are the essential traits of Aristophanes. Frere is a case of genius translating genius.

GRANT SHOWERMAN.

FRÉRON, frā'rŏṅ', **Elie Catherine**, French critic: b. Paris 1719; d. there, 10 March 1776. He was educated by the Jesuits and became professor at the Collègè Louis-le-Grand at the age of 20. In 1739 he became a contributor to literary periodicals and was a strenuous opponent of the encyclopædic movement and of Voltaire, one of its leading lights. His work called forth retorts from Voltaire, among which 'Le pauvre diable'; 'L'Écossaise' and 'L'Ave littéraire' are the most remarkable. Consult Nisard, 'Les ennemis de Voltaire' Paris (1853); Trévedy, J., 'Notes sur Fréron et ses cousins Royons' (ib. 1902).

FRESCO (Buono). See PAINTING, TECHNIQUE OF.

FRESCO PAINTING. The word "fresco" is Italian and means *fresh*. The term "fresco painting" means, technically, painting on a freshly laid wet surface of plaster. The method is employed in the decoration of spaces on walls and ceilings. The pigments used are water-colors. By extension the term has been used to include other systems of painting on plaster and has, at last, become, to some extent, accepted in popular parlance as synonymous with mural decoration in general. Some of the most noted paintings of the early great masters are in this medium.

Technique.—As an absorbent surface is needed on which to lay the plaster background, in cases where the wall structure is of hard, impervious stone, it becomes necessary to add a lining of brick. Over this is spread a three-quarter-inch layer of mortar consisting of lime (at least a year old), well-washed river sand and an admixture of ox-hair or other durable fibre. This coating is combed over coarsely to produce a roughened surface and is left to dry thoroughly (preferably a year) before further manipulation. Next comes the second coating (termed the *intonaco*), on which the painting is done. The aim here is to get this last plaster as absolutely homogeneously mixed as possible, as any imperfections or irregularities in the density of the plaster will cause lack of uniformity in the coating pigments when applied and unequally absorbed. To this end the finest quicklime is slaked and strained through a close-meshed sieve, then even-grained river sand is added till the mixture becomes, on cooling, a «lime putty» or paste. The next process is to saturate the brick surface with water and then lay on the plaster (*intonaco*), starting from the top and covering only as much as will suffice for the day's color work, say five hours, by which time the plaster gets too dry to absorb sufficient pigment, so that it would be likely to scale off later. When too dry the unpainted plaster must be cut away and fresh applied. After the freshly-laid plaster has had about 10 minutes to set it is best coated with a tint that will, when dry, afford a deep vellum surface tone (raw sienna and white lime of cream consistency). Next, the area of the day's color work is traced directly from a cartoon containing the pictured subject, or through a tracing paper copy, by a stylus (point), or by punctured indications of the outlines. The painting now proceeds according to the method and style desired by the artist — applying thin washes as in water-color painting or in thick brushwork (*impasto*), or both in combination. The bolder and larger surface of the brush can be shaded with additional pigment; or shading is frequently done by «hatched» lines. The process involves boldness and lightness of stroke as each application of color is permanent and allows no corrections and any hard pressure disturbs and ruins the soft wet surface. The pigments are limited to: White: lime white; yellow: raw sienna and cadmium yellow; red: vermilion, light red, Indian red; blue: cobalt blue and *genuine* ultramarine; green: oxide of chromium and emerald oxide of chromium or cobalt green; orange: burnt sienna; brown: raw umber, burnt umber; black: ivory black. The strict limitation of the permissible range of pigments is caused by the need of each being able to resist the caustic action of lime in the plaster. This restriction of the palette has caused other processes of painting on plaster to be practised (mentioned later) and, in order to distinguish this original method from others, it has been termed «fresco-buono» (good or *true* fresco). This fresco-buono, correctly carried out, is more permanent than any other painting process, except the silicious glaze decoration in ceramics. The chemical action creating this extraordinary durability is supposed to be caused by the formation of carbonates, and sometimes silicates, of lime on the surface of the plaster while drying; the eliminated carbonic acid of the kiln action being again absorbed from the air by the hydrate and producing, while drying, a hard skin which protects the surface against atmospheric action and becoming damp-proof. It is not, however, impervious to the action of sulphuretted hydrogen thrown off by coal-gas. Other processes of painting on plaster have been invented to avoid the inconveniences of the *wet* or *fresco* method. One is the «fresco-secco» or dry process. Among the old writers «secco» referred to distemper (*tempera*) work, using pigments ground in a binding medium, as egg, glue, size, gum, on a dry wall space. But the term *secco* in recent years refers to any dry processes, such as the German «stereochrome» or «water-glass» process, or the later innovation known as the Keims process. Among other schemes for increasing the usable range of pigments is «spirit fresco» done by grinding the colors in wax, then thinning with spirits of turpentine or oil of spike. The so-called «encaustic» fresco-painting is done by using wax as a medium and after its application it is heated and thereby becomes absorbed, to some extent, by the ground. The English «spirit» fresco, invented by Gambier Perry of Gloucester, was used in decorating Saint Andrew's Chapel in Gloucester Cathedral, etc., also was later employed by Lord Leighton on mural decorations in the Victoria and Albert Museum and other buildings. Time alone is the test as to their durability. As to the technique of the artist in the fresco medium, the fact that a fresco painting is a wall or ceiling decoration involves the consequence that the conceptions, in design and execution, shall be *architectural*. Quite distinct from oil color painting, with its multiplicity of tones and gradations unlimited, the fresco work has, correctly, to consist mainly of more or less flat background that conveys the idea of *surface* more than distance, while the subjects exist more in *outline* and *perspective* than in detail of merging light and shadow.

Historical.— The origin of mural painting on plaster reaches back into very primitive times. Without being hypercritical as to the exact processes used by the ancients, we know, from the excavations by Dr. Schliemann of the pre-Hellenic palaces of Mycenæ and Tiryns (1500 B.C), that the plastered walls and ceilings were decorated in colors. The ancient Egyptian tombs and mummy-cases were decorated with painting on stucco white ground in *tempera* (distemper). The Greeks would appear to have used the fresco process in the period of their prime, although it would seem that their most noted painter, Polygnotos, worked in *tempera* technique. But nothing is extant to afford visual proof. From the Roman period, however, we have fine examples of mural decoration in the ruins of Pompeii, Herculaneum, Stabia, Boscoreale, etc. Besides, Pliny and Vitruvius have left us descriptions of the Greco-Roman technique. Next we come to the fresco painting of the primitive Christians in the Catacombs of Rome and Naples. Then the art appears to have declined and we learn of only isolated examples till we come to the 13th and 14th centuries, when the process again began to flourish. And the art took on greatly advanced and talented execution in the persons of Cimabue, Giotto and other Italian artists. From Florence the pupils of these masters soon spread a knowledge and practice of the art of fresco painting throughout all Italy, some examples of which we will enumerate later. Mural decoration in fresco next became popular in Germany in this period and we find examples in Brunswick Cathedral, in Saint Gereon's, Saint Ursula and Saint Humbert's churches at Cologne. We find them numerous in the cloisters and castles; the «Dance of Death» (*Todtentanz*) is a favored subject. Even the façades of the buildings displayed fresco decorations (mostly allegorical and historical subjects). But with the 15th century we are in the Renaissance, resplendent with fresco paintings done for the church, royalty and the princely nobles. Wonderful genius in fresco work is displayed by Masaccio, Fra Lippi, Ghirlandajo and others. And their successes brought forth the enthusiasm of the 16th century that produced the schools of Florence, Milan and Rome, and created the highest work and most flourishing period in fresco painting. To this period belong the greatest of fresco painters: Perugino, del Sarto, Pinturicchio, Leonardo da Vinci, Luini, Correggio, Raphael, Michelangelo, etc., all great masters in this art. But too soon after the zenith of the fresco painting art followed the decadence with its baroque period of rapid execution running to fantastic perspectives and tours de force. Standing boldly out from such extravagances we have, however, such names as Annibale Carracci with his superlative work in the gallery of the Farnese Palace and Guido Reni has left us fine frescoes in the 'Dawn' or 'Aurora' on the ceiling of the Rospigliosi Villa and others, at Rome. Domenichino did fine fresco painting at Piacenza, Bologna and Rome (Villa Ludovici); Lanfranco achieved success in examples in Rome and Naples. South Germany produced its 16th century fresco painters; Holbein worked in Basle and London; his frescoes are, however, lost, the oils alone remaining. We must remember that the Catholic churches, in this period, did little decorating on their walls. With the increasing popularity in stained glass windows for ecclesiastical buildings, the colored light rays seriously interfered with polychrome effects in mural decoration. Little of importance was brought forth by the 18th century; Tiepolo did some decorating in Würzburg and some Tyrolese, as well as Italians, practised the art on minor works. In the 19th century Germany made an effort to revive the almost forgotten art and started an artists' colony in Rome. Clever workers resulted but their gaudy colors compare ill with the mellow tones of the old masterpieces. We have works in Munich by Cornelius, the Berlin Museum has decorations by Kaulbach. There were Veit and Schadow (seven pictures of 'History of Joseph' in the Berlin National Gallery), etc. Ludwig I of Bavaria, as art patron, aided by the guidance of Cornelius, had what are termed the best recent fresco decoration done in the Munich Glyptothek; Schnorr's 'Nibelungen' salon in the Imperial Palace is another noteworthy work.

Noted Frescoes.— Giotto's (1276-1336) 'Birth of the Virgin,' etc., are in the Bardi Chapel, his 'Scenes in the Life of Saint Francis of Assisi,' others in Santa Croce, Church of Santa Maria Novella ('Birth of the Virgin,' etc.) are best examples. By Beato Fra Angelico (1387-1455) the best extant works are 'Crucifixion,' 'Annunciation,' etc., in Saint Mark's monastery, where are also some of those of his less talented brother Fra Benedetto. Massaccio (1401-28) is well represented by his grand work in the Brancacci Chapel of Santa Maria del Carmine ('Tribute Money,' etc.). Benozzo Gozzoli (1420-97) creations are found in the Riccardi Palace, consisting of many portraits (the Medicis), the 'Journey of the Magi,' etc. All these are by Florentine artists and in Florence. The Gozollo series of paintings at Pisa in the Campo Santo are noted. Pietro Vannuchi, called «Perugino» (1446-1524), was teacher of Raphael and is represented by such work as the 'Crucifixion' in Santa Maria Maddalena de'Pazzi, Florence; the 'Baptism of Christ' in the Vatican, etc. Bernadino di Betti, called «Pinturicchio» (1454-1513), has left us 'Saint Catherine before Emperor Maximianus,' in the Vatican and scenes from the life of Saint Bernard of Siena in Santa Maria Araceli, Rome; others in the Sistine Chapel. Domenico Bigordi, called «Ghirlandajo» (1449-98), is represented by his 'Calling of Saints Peter and Andrew' in the Sistine Chapel and other works in Santa Maria Novella and Saint Trinita, in Florence. Andrea Vannuchi, called «del Sarto» (1488-1530), has extant his 'Death of Saint Filippo' and other works in Florence. The wonderful frescoes of Raphael (1483-1520), 'The School of Athens,' 'Jurisprudence,' 'Parnassus' and 'Theology' in the Vatican are peerless. Michelangelo Buonarroti's (1475-1564) great fresco 'The Last Judgment' is on a wall in the Sistine Chapel (Rome), together with his ceiling decoration 'Story of Genesis,' etc. Luini, pupil of da Vinci, did fine fresco work as is proven by his 'Virgin and Child' and 'Saint John' at Lugano. Da Vinci (1452-1519) did his world-renowned wall painting 'Last Supper,' in oil-colors and the great work is rapidly decaying by scaling off; no *fresco-bueno* work of his is known.

Bibliography.— Gruner, L., 'Fresco Decorations and Stuccos of Churches and Palaces in Italy during the 15th and 16th centuries' (London 1854); Merrifield, Mrs. M., 'The Art of Fresco Painting as practised by the Old Italian and Spanish Masters' (London 1846); Mérimée, J. F. L., 'The Art of Painting in Oil and Fresco' (London 1839); Ward, J., 'Fresco Painting; Its Art and Technique' (London 1909).

CLEMENT W. COUMBE,
Technical Art Expert.

FRESCO-SECCO. See PAINTING, TECHNIQUE OF.

FRESCOBALDI, frĕs'kō-băl'dē, **Girolamo,** Italian organist and composer: b. Ferrara, 1583; d. 1644. He studied with Luzzaschi at Ferrara and later removed to Belgium. About 1614 he became organist of Saint Peter's, Rome, and remained in this position until his death, with the exception of an interval, 1628-33, when he was court organist at Florence. He is equally famous as a composer and organist. His compositions include canzones, motets, hymns and madrigals. Consult Haberl, F. X., 'Frescobaldi' (Leipzig 1887).

FRESCOS, Boscoreale. See ART, METROPOLITAN MUSEUM OF.

FRESH-AIR WORK, a form of benevolence or helpfulness; in this particular the taking of poor children from the tenements and slums of large cities to the country or seashore for recreation. It is said to have originated in 1849, when Rev. William A. Muhlenberg of New York sent a large number of poor children and invalids from his parish to the country for short vacations. In 1872 the New York *Times* inaugurated a system of free excursions and its example was followed in other parts of the country. The first general fresh-air societies were organized in 1874, and since then a number of newspapers have inaugurated fresh-air funds. There are now nearly 100 societies and 14 fresh-air organizations in New York. General agencies, church organizations and private funds provide for between 2,500,000 and 3,000,000 days' outing for poor children of the cities. The beneficiaries are for the most part children from 6 to 12 years old. A few adult women usually accompany them. They are sent away from the city for periods varying from a few hours to a fortnight spent in the so-called country homes, or as the guests or boarders of private families. In Europe, Switzerland was the first to take up the movement in 1876. In 1895 there were 73 fresh-air colonies in that country. Nearly all European countries and Argentina in South America have taken up the work. It is also common in Germany and Denmark for the artisan classes in the city and country to make a temporary exchange of children during a part of the summer. Consult 'Fresh Air Charity in the United States' (1897); Delpérier, 'Les colonies de vacances' (Paris 1908); Allen, 'Sea Air Treatment for New York's Bedridden Children' (in *Review of Reviews*, Vol. XXXII, New York 1905).

FRESH-WATER INSECTS. Insects are essentially creatures of the air and the land; yet a considerable number pass the whole or the greater part of their lives in rivers, lakes and ponds. Among insects aquatic in all stages we can distinguish between those which glide or skate over the surface of the water, diving not at all, or only exceptionally, and those which habitually dive and swim through the water after the manner of fishes. The most typical of the surface-dwellers are the bugs of the family Hydrometridæ. See POND-SKATERS.

Among the Coleoptera the whirligig beetles (*Gyrinidæ*) frequent the surface of ponds and brooks where they may be seen in small companies, performing a whirling, mazy dance over the surface-film. These insects, when they dive, carry down with them a small air-bubble enclosed in a film between the tip of the wing-covers to the hinder end of the abdomen. They are not, like the pond-skaters, completely enveloped in air while under water. The beetles of a nearly related family (*Dyticidæ*), well called «diving-beetles,» belong to the group of insects which live habitually submerged. Their contours are admirably adapted for motion through the water, but there is no dense hairy covering to ensure the formation of an air-bubble and the breathing is provided for in quite another way. The abdominal spiracles open on the upper surface of the segments, which are completely covered by the wing-cases when the wings are shut. The wing-cases being convex and the upper surface of the abdomen depressed, a considerable amount of air is enclosed, allowing the insect to remain submerged for some time.

Another mode of adaptation to life in the water is shown by the water-scorpions (*Nepidæ*). They are provided with a pair of long-grooved appendages at the tail-end of the body; these can be closely pressed together and form a tube, the tip of which pierces the surface-film and conveys a supply of air to the spiracles. These insects, like the allied «water-boatmen» (*Notonectidæ*), have well-developed wings, and make excursions by night to new watery dwelling-places.

Many insects lead an aquatic life only during their larval stage. Naturally enough, however, such insects when adult are to be found flying chiefly in the neighborhood of water in which they will lay their eggs — the May-flies and midges for example. The contrast between the conditions of the larval and the imaginal life in such cases is most striking, and can only have been brought about by slow degrees. A certain amount of moisture in the earth is necessary to the well-being of many burrowing larvæ, while some are found in semi-liquid mud, in decaying refuse, or in animal excrement. In such surroundings breathing through the lateral spiracles becomes impossible, and we find that access to the air-tubes takes place only by one or two pairs of spiracles near the head or tail-end of the body, sometimes opening through «respiratory trumpets» whose expanded mouths can be thrust out of the clogging surroundings of the mud or refuse into the fresh air, while the grub remains concealed and continues to feed. A similar suppression of most of the spiracles, with the development of a tubular process at the tail end of the body in connection with the tracheal system, is the adaptation by which many aquatic larvæ breathe — for example, the grub of the mosquito. The families of insects nearly related to these have larvæ which live in mud and damp earth, and this suggests that it was from the shores that the waters were invaded by these insect-hosts.

But there is another division of aquatic larvæ still more perfectly adapted to life in the water. The grub of the gnat or the drone-fly needs to rise to the surface at intervals and pierce the film with its air-tube in order to get a fresh supply of oxygen. But the pupa of the sand-midge, with its tubular gill-filaments, or the larva of a May-fly with its tracheal gill-plates, can remain in the water throughout its life, drawing, as do the fishes, sufficient oxygen from the dissolved air. It is interesting to notice that within the limits of a single and restricted order — the dragon-flies — we find some larvæ breathing by means of tracheal gill-plates, and others taking supplies of water into the hind-gut over whose walls run branching air-tubes; while in the final nymph stage the thoracic spiracles are open, and the insect raising the front part of its body above the surface, breathes through them after the manner of an imago. These various adaptations to an aquatic life within a single group indicate clearly that the habit of living in water is not primitive among insects, but that it has become acquired by different races at different times in the course of the development. It may be presumed that larvæ with the more perfect adaptations for breathing when submerged — leaf-like or thread-like gills — are older inhabitants of the water than those which have to rise periodically to the surface to take in a supply of air.

FRESH-WATER MUSSELS, bivalved mollusks that dwell in lakes and rivers; river-mussels, or river-clams. They belong to the family *Unionidæ,* allied to the cockles, which has a large and thick foot, no byssus, siphon short (when present), and a parasitic embryonic growth. The shells are equivalve, varying according from thin and smooth to very thick, rugose and knobbed; the hinge variable (in *Anodonta* having no hinge-teeth); and the interior always thickly nacreous, making it useful in the arts as «mother of pearl,» and often producing fine pearls. The family is world-wide in its distribution and includes about a dozen genera, two of which (*Unio* and *Anodonta*) occur in most parts of the world. These mollusks dwell in rivers and ponds, and vary greatly according to the character of their home, whereby a great number of supposed species have been named that are now known to be merely varieties of the same stock resulting from different environment. They stand upright in the sand on the blades of the shell, so that the heavy hinge margin receives any blow from drifting stones, or other harm; and slowly move about, sucking in the minute animal and vegetable organisms upon which they feed. (See PELECYPODA). The development of their young is most unusual. The eggs when ejected from the ovaries are caught in the gills of the mother and are sustained by a nutritive mucus-like secretion, until they reach a certain degree of age, when they become «glochidia.»

They then have a larval shell, provided with strong hooks, and possess a long filament. After a period they are expelled through the exhalent siphon into the water, and this ejection may be timed to the passing of a small fish, to whose body if they touch it the glochidia at once cling by means of the hooks. Should they miss striking against a fish when thrown out the embryos sink and lie upon the bottom with their shells gaping and the filament floating upward. There they remain until a «host» comes within reach; but this must soon happen or they will perish. The glochidia of *Unio* usually become attached to the gills; those of *Anodonta* to the skin or the fins. In this position they become overgrown by the skin or mucous membrane of their host, and are nourished by his juices. This goes on for about 10 weeks, during which time the glochidium has been metamorphosed into a young normal mussel, drops off and begins the ordinary course of life. Their life is probably long.

Mussels abound in all the rivers of the United States and were extremely numerous and varied in those of the Mississippi; and they entered very largely into the fare of the native red men, as is attested by the large refuse-heaps of their shells to be found in all the river courses. It was long ago discovered, however, that these shells yielded pearls of great beauty and price (see PEARL), while the mother-of-pearl of many species was marketable for the manufacture of buttons and similar articles. The result has been a serious depletion of the mussels of many parts of the Middle West, and nearly an extinction of some species. Consult Lefevre and Curtis, 'Studies in the Production and Artificial Propagation of Fresh-Water Mussels' in the United States Fisheries Bureau Bulletin (Vol. XXX, Washington 1912), and other publications of the department.

FRESNEL, frā'-nĕl, **Augustin Jean**, French physicist: b. Broglie, France, 10 May 1788; d. Ville d'Avray, near Paris, 14 July 1827. He was educated at the École Polytechnique and the École des Ponts et Chaussées, and early devoted himself to the practice of civil engineering. He served as government engineer in La Vendée and subsequently in Drôme. During the Hundred Days he was persona non grata to Napoleon, but after Waterloo he returned to Paris to his former occupation of engineer. In 1815 he became distinguished as the discoverer of the polarization of light, and in 1823 was elected a member of the Academy. He made important researches respecting the wave theory of light, and proved Newton's theory wrong so ably that Arago, long an opponent, was converted to the new hypothesis. The result of his great discovery is shown in the system of lens lighting apparatus, which has changed the mode of lighthouse illumination over the whole world and is universally known as the «Fresnel system.» In 1825 Fresnel was elected Fellow Royal Society of London, and in 1827 received the Rumford medal of the society. Consult Arago, D. F., 'Distinguished Scientific Men' (Boston 1859); Moon, R., 'Fresnel and His Followers' (Cambridge, England, 1849).

FRESNEL'S SURFACE. See LIGHT.

FRESNILLO, frĕs-nĕl'yō, Mexico, a city in the state of Zacatecas, on the Mexican Central Railway. It has a spacious square, with a fountain in the centre, and contains several large churches. In its vicinity are the celebrated mines of Fresnillo. Elevation nearly 6,900 feet above sea-lev l. Pop. about 6,500.

FRESNO, Cal., city and county-seat of Fresno County, situated on the San Francisco and San Joaquin Valley, the Southern Pacific and Atchison, Topeka and Santa Fe railroads. The city is an important fruit-growing centre, the raisin trade alone being valued at $5,000,000 annually. Other important industries are the cultivation and exporting of oranges, grapes and olives, besides a large livestock trade. The United States census of manufactures for 1914 showed within the city limits 117 industrial establishments of factory grade, employing 3,330 persons, 2,903 being wage earners receiving annually a total of $1,511,000 in wages. The capital invested aggregated $7,375,000, and the year's output was valued at $16,520,000: of this, $4,349,000 was the value added by manufacture. Fresno was settled in 1872, became the county-seat in 1874 and received a charter as a city in 1885. The government is controlled by a mayor, chosen every four years, a municipal council and other administrative officials. The assessed property valuation is about $22,000,000. Pop. (1916) 45,000.

FRETUM GALLICUM. See BONIFACIO.

FREUD, froid, **Sigmund**, Austrian psychiatrist: b. Freiburg, Moravia, 6 May 1856. He studied medicine at Vienna; was appointed demonstrator at the physiological institute, and subsequently assistant at the Vienna General Hospital, where he also lectured on diseases of the nerves. At Paris he studied for a year under Charcot in 1885–86 and in 1902 was appointed associate professor of neuropathology at Vienna. In 1909 he came to the United States. Freud's reputation is international owing to his psychoanalytical treatment of hysteria and especially to his theory of dreams. He published 'Zur Auffassung der Aphasie' (1891); 'Studien ueber Hysterie' (1895; English translation by Jelliffe and White 1913); 'Traumdeutung' (1900; 3d ed., 1911; trans. by Brill, 'Interpretation of Dreams,' 1913); 'Ueber den Traum' (1901; 2d ed., 1911); 'Psychopathologie des Alltagslebens' (1904; English trans. 1914); 'Der Witz und seine Beziehung zum Unbewussten' (1905; 2d ed., 1912); 'Drei Abhandlungen zur Sexualtheorie' (1905); 'Sammlung kleiner Schriften zur Neurosenlehre' (1906; 2d ed., 1911); 'Zweite Folge' (1909; 3d ed., 1913); 'Ueber Psychoanalyse' (1910; 2d ed., 1912); 'Totem und Tabu' (1913). He edited *Jahrbuch für psychoanalytische und psychopethologische Forschungen; Internationale Zeitschrift für ärztliche Psychoanalyse; Imago;* and *Schriften zur angwandten Seelenkunde.* See FREUDIANISM; DREAMS.

FREUDENTHAL, froid'en-tâl, **Jacob,** German philosopher: b. Bodenfelde, Prussia, 20 June 1839; d. Breslau, 1 June 1907. Twenty years teacher in the Rabbinical Seminary of Breslau (1864–88), he was successively lecturer, assistant professor and professor in philosophy at the University of Breslau (1875–88), dean of its philosophical faculty (1898–99). He was sent to England (1888) by the Prussian Academy of Science to study English philosophy, and to the Netherlands (1898) for research work on the life of Spinoza — the results being his 'Contribution to English Philosophy,' in the *Archio für Geschichte des Phil.* (IV, 400 et seq., V, 1 et seq.) and his 'Die Lebensgeschichte Spinoza's' (Leipzig 1899). In the field of Greek and Hellenistic studies, he wrote, besides various essays, 'Hellenistic Studies' (1875–79); 'On the Theology of Xenophánes' (1886); in addition to a treatise on Aristotle's conception of *Phantasia* (1863); and another on Josephs' assumed work on the rule of reason (1869). His son Berthold (1872) is professor of law at the Academy of Social and Industrial Sciences at Frankfort-on-the-Main.

FREUDIANISM. The name applied to the views of the most modern school of psychology and philosophy, of which Sigmund Freud (q.v.) is the central figure. The governing conceptions of contemporary scientific psychology fall into three classes. One class regards mind and body as coordinate and parallel functions of one another. It does not assume any causal connection between two mental states. In the laboratory it aims to check up introspection by the control of its conditions, and it is content to record the structure of these states as introspection, so controlled, reveals them. Another class regards consciousness or mental states as such as non-existent. What is normally called consciousness it describes as *behavior* (q.v.). In the laboratory it replaces introspection by rigidly controlled observations of the reaction of sentient beings to stimuli. This reaction, which is to its last detail physiological, is considered *with* its stimulus, as the mental unit of behavior. Hence, for the first group, consciousness runs parallel to the interaction of the body, or of a state of the body, with its environment. It is a third and later entity, which appears after the other two already exist, while for the second group consciousness *is* the response or behavior of the organism toward its environment. For the first group psychology is purely a descriptive science; for the second group psychology is an explanatory science which differs, however, from physiology in that it takes into account not the organism alone, but the organism together with the environment to which it responds. The third class falls between the other two. It believes in the reality of consciousness with the parallelists, and with the behaviorists it believes in its *functional* character. From the point of view of *functional psychology* consciousness modifies both the organism and its environment and is reciprocally modified by them.

All three of these conceptions are alike in that they have not succeeded in formulating any precise *law* of the rise, operation and subsidence of ideas. The so-called «law of association» is nearest to such a law; but that is rather a formulation of the conditions under which ideas appear together than a statement of their dynamic relationships and bases. It does not, nor does any other of the current hypotheses, unify the various processes of willing, feeling and thinking under a single causal concept.

Such a unification is, however, precisely what Freud effects. Psychologists have, on the whole, paid little and unflattering attention to Freud, but Freud has been the first to express the process of consciousness in a single causal pattern which can utter and coordinate in genetic terms *all* the phases of consciousness, in all degrees of normality and abnormality. The pattern may be designated as follows: Mind, like body, consists of distinct units of action, which Freud calls «complexes» or wishes. These are normally integrated and fused. The essential conditions of life are, however, such that not all can be realized or satisfied at one and the same time. Some can never be realized. Life, consequently, consists of constant choices between conflicting alternatives, of which many must be repressed if the course of life is to go on at all. The repression may be complete or partial. When it is effected, it does not destroy the wish; it renders the wish *subconscious.* The subconscious wish may then be completely dissociated from the conscious life and alternate with it, or it may *emerge* against the repressive factor, with a resultant in feeling, attitude and ideas that constitutes the overt state of consciousness and behavior. Every phase of a state of mind may be accounted for in these terms, which are ultimately reducible to the action of the primary instincts of self-preservation, sex, hunger and gregariousness.

Mind thus becomes an interplay and resultant of separate conational units, whose operation can be graphed as the physicist graphs the operation of lines of force. So stated, the view contains nothing novel. It is the same which Spinoza has worked out in detail in his 'Ethica' and which William James expressed in so many places in his 'Psychology.' Freud, however, adduces a wealth of empirical evidence, in which the *schema* of the causal process stands out clearly, and the movement from conflict to repression, dissociation, censure and emergence, in rationalization, symbol and fantasy is actually seen in the coming and going of states of mind. Freud's contributions fit in best with the concept of functional psychology. The behaviorists have, however, been the most hospitable to his ideas. In 'The Freudian Wish' Mr. Edwin Holt has very cleverly reduced the "complex" to the responsive mechanism of the reflex arc and its object. The whole of mind is there stated as the conflicts and integration of the varieties of this mechanism; "complex" "consciousness" and "subconsciousness" become superfluous and the Freudian system becomes one aspect of the larger system of behavior of living organisms.

Philosophy as such has as yet paid little or no attention to Freudianism. But Freudians and others have paid a good deal of attention to philosophy and philosophers. In this connection the analysis of systems and system-builders brings additional confirmation of William James' description of the non-logical motives in system-building. Hans Sachs and Otto Rank have divided philosophies into three types according to the instinctive motives in play: (1) that of the intuitive spectator or artistic metaphysician like Plato; (2) that of the synthetic thinkers like Comte, Spencer and Locke; (3) that of the analytical thinker like Kant, Spinoza, Hume. Their classification and examples are not convincing, but the line of investigation is promising.

To the persistent problems of philosophy the Freudian hypothesis contributes another confirmation of determinism in the controversy over the freedom of the will, and perhaps a mitigation and even an abolition of the problems by exhibiting the perennial wishes and conflicts that make persistent such difficulties as "the many and the one," "the immortality of the soul," "the existence of God," "the freedom of the will," "eternity and time." Whether it can add anything positive to metaphysics is extremely doubtful. Because of its conception of memory, forgetting and the subconscious, it has been claimed in confirmation of the Bergsonian philosophy (q.v.), but its treatment of these facts is diametrically opposed to that of Bergson. So far it has been most fruitful and original in the social sciences — in ethics and its derivatives. E. B. Holt's 'The Freudian Wish' is an essay in this field, in which a *rapprochement* is established between Freud and Aristotle. The ethical and social conclusions derive from the clear and distinct apprehension of the causal pattern of mental life, of the importance of conflict, of the constant oppositions of such fundamental instincts as that of sex and gregariousness, self-preservation and the groupings of individuals according to class, family, nation and so on. Once the detail of *causal pattern* of conscious life is fixed, it is bound to be a clarifying conception in education, ethics and religion rather more than in the purely technical philosophic disciplines like logic and metaphysics.

Bibliography.— Hart, 'A Philosophy of Psychiatry' (*Journal of Mental Science,* July 1908); Rank, Otto, and Sachs, Hans, 'The Significance of Psychoanalysis for the Mental Sciences' (*The Psychoanalytic Review,* October 1915, January, April, July 1916); Jung, 'Psychology of the Unconscious' (New York 1916); Kallen, H. M., 'William James and Henri Bergson' (Chicago University Press, Chicago 1914); Holt, 'The Freudian Wish' (New York 1915).

H. M. Kallen.

FREUDIANISM, Medical. The medical or therapeutical aspect of Freudianism claims priority in point of time over its distinctively psychological and philosophical application, since psychoanalysis developed out of therapeutic experience and primarily as a method of investigation and treatment of nervous disease. Still the very fact of its rapid development in these other spheres emphasizes its broader and its profoundly fundamental service in establishing a comprehensive genetic basis for therapeutic knowledge and practice. Under its conception neurotic disturbances together with the far-reaching physical phenomena dependent upon them are concerned with the patient's entire attitude toward reality, his attempt at self-expression in regard to it which involves his success or failure of adaptation toward it. Therefore it presupposes a psychological and philosophical attitude on the part of the physician in order to comprehend the patient's problem as well as to guide him to a normal adjustment to life as a whole.

Psychoanalytic investigation has thus of necessity led into a pragmatic psychology and philosophy whose scope is all-embracing and whose foundation is laid in the genetic development and dynamic potentiality of human life. The therapeutic side is inseparably bound with such implications of the psychoanalytic method for a new comprehension and control of both individual and general medical problems. In this way it has enlarged the conception of medicine and quickened it by this introduction and use of the dynamic genetic element.

It was while Freud was working as a pupil of Charcot in 1885–86 that he was led to his method of investigation of hysteria. Both Charcot and Janet discovered through hypnosis something of the hitherto unknown mechanisms of hysteria as the results of ideas which have temporarily gained mastery of the patient's mental apparatus. Freud followed up their observations together with Breuer, who had been able to demonstrate through hypnosis the psychic traumatic experience which was the cause of the hysteria and to discover the fact that the symptoms disappeared when the memory of the traumatic event was brought to clear consciousness and the emotion or effect originally accompanying it could be thus discharged. Freud then applied this cathartic method to a number of cases and with Breuer conceived of the hysterical symptoms as the manifestations of such mental traumas converted into bodily symptoms. This involved an elaboration and a much farther reaching extension of the original concept to account for the elaborate mechanisms which were gradually discovered at work. Freud carried this work forward into all forms of the psychoneuroses and discovered in all the same fundamental etiological factors as in hysteria.

Briefly considered his significant recasting of the etiological conception of neurotic disturbances includes the following features. Behind certain definite traumatic experiences first discovered in certain cases of hysteria there appeared to lie still earlier experiences reaching back into the forgotten infantile period. Meanwhile also the theory of a definite traumatic experience proved itself by no means always valid and this was gradually given up for a more comprehensive background of psychic predisposition in which infantile experiences phantasied as much as actual were stored up to contribute at a later period of psychic stress their accumulated effect toward a psychic disturbance. A working hypothesis was necessary to fit the facts revealed by psychoanalytic therapy which discovered these stored up memories and effects, and for this Freud adopted the concept of the unconscious, a mental sphere in which the past is conserved unrecognized but not inactive. Into this unconscious are relegated all those experiences and phantasies which belong to infantile years and to infantile modes of expression but which are not compatible with an adult position in a social, cultural environment. Nevertheless these experiences and phantasies represent the strongest instinctive forces and desires of mankind, his deepest wishes. Hence they can be banished only by the force of «repression.» These infantile instinctive desires are common to normal and neurotic alike, but in the former case the repression is successful as the effect associated with the infantile manifestation of the desire or the infantile experience is adequately discharged at the time or finds a sufficient substitution channel and is thus «sublimated.» In many cases, however, such a sublimation is not found and the effect undischarged is repressed together with the experience which it accompanies.

It is the special nature of these instinctive impulses which causes the strength of the repression, for they lie in the sexual sphere. It was here that Freud performed a striking service in opening up the nature of infantile sexuality. His investigations have proved the existence of the sexual impulse from the earliest years but in its «polymorphous,» undifferentiated manifestation, when it is not as yet converged into the central sexual aim but is diffused throughout the many forms which are essential as contributory in the course of normal development to the primary aim. They afford also, as in the history of the race, opportunities of desexualization and diversion of the primeval energy or libido from the strictly sexual into the various paths of sublimation which have built up civilization and are necessary for individual as for racial advance. They offer also in those constitutionally disposed to disturbance occasions for over emphasis of one or another of these polymorphous components. This causes fixation of infantile interest upon it with arrest in so far of normal psychic development, or according to Freud in conception later worked out by the Zurich school, pathways ready to receive a retrogression of the energy or libido when in later life some obstacle in its course drives it back to reanimate these pathways at the expense of the adult form of reaction.

Whether occupied with actual traumatic occurrences or with phantastic formations of childhood, primitive and infantile ways of thought and reaction fixed through life or revived through repression find themselves incompatible with cultural demands. The early content of experience or of phantasy is of a forbidden nature and therefore repressed but its affect continues to seek adequate expression. Hence arises an unbearable conflict. The only escape from this is through some form of compromise formation which will satisfy the unconscious wish and at the same time accord with the ethical demands of conscious life. The result, therefore, is the protean symbolism of hysteria, conversion into bodily symptoms, the compulsive idea, the compulsive act, the obsession, the whole train of phobias, and passing on to the realm of the actual psychoses or mental derangements, the whole range of symbolic acts which serve as nature's attempt to heal the breach between conscious and unconscious and substitute for the conflict this imperfect and a social but individually more bearable compromise.

The therapy of psychoanalysis consists then in the discovery of the hidden source of the conflict, bringing the original wish impulse to clear consciousness and thus discharging the affect bound with it. The ultimate goal always before the physician is the freeing of the regressed and diverted libido and directing it into paths of sublimation which will desexualize it for useful, active work and substitute such a form of satisfaction for the wasteful energy discharge of a futile round of self-perpetuating and distressing symptoms. For the libido as conceived by Freud and particularly defined and developed by Jung of the Zurich school, is the sum of creative energy originally designed for the reproduction and perpetuation of the race but in the course of development and expansion necessarily demanded along the countless pathways of sublimation. The force of the original impulse has not found even its biological reproductive outlet or has failed in satisfaction there probably because of the infantile fixations and the readiness of the regressive pathways to receive the libido at the first serious obstacle presented by external circumstances. The substitute symptom formations then take the place of the sublimations which naturally follow the normal healthful development of the love life. The aim and effort of clinical psychoanalysis is thus to release the libido from its regressive occupation with the ego wishes and direct it along the path of racial, that is social and cultural progress in order thus to attain also the satisfaction of the individual creative impulse.

This is the general principle of investigation into the sources of disturbance and of the method of treatment. It has been adapted to the understanding and treatment of the hysterias, compulsions and the like which distinctly have their origin in the infantile period, and also to those more acute forms of disturbance which Freud has called the true neurasthenias and anxiety neuroses, the origin of which lie in present conditions. The essential disturbance and treatment are the same in the latter forms of neurosis, and at the same time there is frequently a background of the same infantile condition and mode of reaction as in the former cases. Psychoanalysis has thrown much illumination upon the understanding of the psychotic or profound mental disturbances, particularly those of purely functional nature as well as upon the symptomatic manifestations of those of organic and toxic origin. Its therapeutical value has also been demonstrated here in so far as such patients are accessible to the co-operation with the work of the physician which is an indispensable part of the psychoanalytic procedure. The application of psychoanalysis to the psychoses, particularly dementia precox, has been largely the work of the Zurich school.

The method of psychoanalytic therapy requires a highly specialized technique in order to penetrate, correlate and readjust this wealth of plastic human material. This specialized technique was the result of Freud's careful and detailed research based upon his experience with hysteria and its subsequent development. His masterly insight and critique discovered and elaborated the «royal way» into the unconscious storehouse of affective experience and phantasy through the interpretation of the dream. This revealed not only the extensive symbolism under which the unconscious content concealed itself and obtained partial escape in a way acceptable to conscious thought, but also threw illumination upon the various mechanisms utilized in system formation as in dream work, technically known as condensation, substitution, distortion, manifestation through the opposite and the like, all of which have to be understood in order for the physician to guide the patient into the source of the disturbance and out through a revaluation and readjustment in an adequate discharge.

He discovered also the fundamental factor in the success of the treatment and with characteristic fearlessness and clarity of presentation has led his followers to an appreciation of its importance and a recognized utilization of it as an indispensable aid. This is that phenomenon to which Freud has given the name of the «transference.» It represents an essential element which enters into all human relationships but into none more conspicuously than into the success of medical treatment, mental or physiological. Yet it has been unrecognized in its real significance. Its share in the treatment has been either undervalued or because it was not properly understood it has sometimes interfered with treatment to a very serious extent. Its potentiality for service as its capacity for interference lies in its essentially dynamic character. Briefly defined it is that psychic ability on the part of the patient to bring over to the physician the whole burden of his psychic life and find in him the sense of power and security which the infantile neurotic character seeks in a heightened degree. It represents an aim of all human desire and thus enters into every relationship, particularly of the patient who feels his sense of weakness aggravated by any disease, but it plays a particularly large rôle in the infantile character of the mental and neurotic disturbances. On the basis of this Freud and his followers have shown it to be the psychoneurotic attempt to revive the infantile parent images and the supreme security which they afforded the infantile period. Through this then the physician gains the complete confidence necessary for the intimate and complex investigation of profound individual problems, while on the other hand he must utilize the confidence and affection gained to stimulate the patient to participate actively on his own part in the analysis and the accomplishment of the final aim, the freeing of the patient from a condition of infantile dependence, which without keen watchfulness would become intensified about this very factor so essential for successful treatment. The nature of the transference as Freud has understood it furnishes one of the clearest evidences of the nature of the unconscious mental conflict.

It is here that Freudianism shows its departure from the more partial therapy of hypnosis. The earliest psychoanalytic discoveries arose out of experience in hypnotic treatment and Freud at first employed this earlier method of approach to the unconscious. He soon, however, surpassed its inherent limitations and realized the advantage of the conscious co-operation of the patient in the detailed investigation of the unconscious and its minute analysis. Hypnotic success was recognized as a special example of the working of the transference phenomenon whereby the physician, by adopting a rôle which in reality represented the original parental attitude, created the condition of supreme dependence and received the unconscious revelations of the patient who through hypnosis had entered into the infantile world. In this condition of things there was a fruitful field for suggestion and its effect. Freud nevertheless soon discarded suggestion as he left hypnosis behind, for he perceived that a complete and permanent result was assured rather by the patient's co-operation and by the gradual realization on the part of the patient of the meaning of his conflict and the way out of it, than by the acceptance of suggestion which was conditioned by an infantile attitude of dependence.

Psychoanalytic therapy has hardly as yet passed beyond the stage of its infancy. But it arose out of experience and has been unfolded through its application to a large class of sufferers who were finding effective relief in no other manner. It is for this reason a method that deals with vital human problems and reveals a way of understanding them hitherto unknown. It claims to be only a pragmatic tool in the making, but one which carving into the pressing realities of modern existence must either evince its utter worthlessness or be perfected and enlarged in the process of application. Its results are already attested by signal success in many cases where a life condemned to a useless round of meaningless ceremonies, of profitless ineffectual effort, or of painful never solved struggle has given place to a clear self-understanding and a control of forces toward productive work and purposeful adjustments. It has moreover brought an illumination into the dark problems of mental disease suggestive of great promise for the future and likewise thrown much light in the direction of a clearer understanding of physical symptoms as avenues for psychical expression and thus of the relationship of mind and body. The clinical and therapeutic advance which this signifies has scarcely as yet made an entrance into general medical comprehension and appreciation, but through the results of their application psychoanalytic principles are steadily gaining ground.

Bibliography.— Hitschmann, 'Freud's Theories of the Neuroses' (New York 1913); Freud, 'Three Contributions to the Theory of Sex' (New York 1916); Jung, 'Psychology of the Unconscious' (New York 1916); Jelliffe, 'Technique of Psychoanalysis' (Nervous and Mental Disease Monograph Series No. 25). Articles on transference, Freud, 'Bemerkunjen ueber die Uebertragungsliebe' (*Internationale Zeitschrift für Aerztliche Psychoanalyse,* III,

1); Ferenczi, 'Introjektion und Uebertragung' ('Psychoanalytischen Jahrbuch,' 1909).

SMITH ELY JELLIFFE.

FREUND, froint, **Herman Ernst,** Danish sculptor: b. Uthlede, Hanover, 15 Oct. 1786; d. Copenhagen, 30 June 1840. At first a blacksmith, he studied at the Copenhagen Academy of Fine Arts, won the academy's large gold medal with allowance for foreign study, and resided in Rome from 1817 to 1828, where he was greatly assisted in artistic progress by Thorwaldsen and executed his 'Mercury' and 'Luke.' His conspicuous successes were produced in the domain of Norse mythology, to which field belongs his Ragnarök frieze, not finished until after his death, when it was placed, in 1841, in the Christianborg Palace, where it was destroyed by fire in 1884. Other works by him are 'Eurydice,' 'Thor' and 'Mimer and Bolder Consulting the Norns,' and a monument of Hans Tousen at Viborg. After his return to Copenhagen he became teacher and director at the Kunstverein and later at the Academy of Fine Arts. Consult Freund, V., 'H. E. Freund' (1883); Solter, M., 'H. E. Freund, Danish Sculptor' (in *Scandinaira,* Vol. II, p. 148, Chicago 1885).

FREUND, Wilhelm, German classical scholar: b. Kempen, Posen, 1806; d. 1894. He was of Jewish parentage, was educated at Berlin, Breslau and Halle, was professor at Breslau 1828–29, Hirschberg 1848–51, at Gleiwitz 1855–70, and at Breslau after 1870. His greatest work is the 'Wörterbuch der lateinischen Sprache' (1834–45), based on Forcellini's lexicon. Other important works were the 'Gesamtwörterbuch der lateinischen Sprache' (1844–45); and 'Lateinisch-deutsches und deutsch lateinisch-griechisches Schulwörterbuch' (1855); 'Wie Studirt man Philologie?' (6th ed., Stuttgart 1903); 'Tafeln der Litteraturgeschichte' (1877); 'Triennium Philologicum' (3d ed., 1906 et seq.); the series of 'Präparationen zu den griechischen und römischen Klassikern' (1859 et seq.); 'Wanderungen auf Klassischem Boden' (1889–92). Andrews, Lewis and Short, Riddle and White, and Dr. Smith based their Latin-English dictionaries on Freund's work.

FREY, or **FREYR,** frār, the son of Njörd, of the dynasty of the Vanagods. He is the god of fruitfulness and peace, patron of marriage and had his chief temple at Upsala. He was greatly venerated in Sweden, Norway and Iceland. For a full account of his genealogy, his exploits and the worship rendered him, consult Paul, 'Grundriss der germanischen Philologie' (Vol. III, Strassburg 1900).

FREY, frī, **Emil,** Swiss statesman: b. Arlesheim, near Basel, 24 Oct. 1838. While in the United States in 1861 he enlisted as a sergeant in the Federal army, was taken captive at Gettysburg and confined in Libby Prison. He returned to Switzerland in 1865, there becoming prominent as a journalist, and was Minister from Switzerland to the United States 1882–87. In the Nationalrat he was a leader of the Left in 1872–82 and president in 1875–76. He was elected President of the Swiss Confederation 14 Dec. 1893. He is a noted advocate of educational progress and reform and has been prominent in the furtherance of public works and of army improvement. Frey was one of the most prominent supporters of the Saint Gotthard tunnel project and of other great enterprises to facilitate communication. Other projects dear to him were a greater and better army, an improved and extended system of frontier fortifications and a change in the forestry conservation system. He was appointed director of the International Telegraph Bureau at Bern in 1897, and 1906 presided at the first conference for the International Protection of Wage Earners.

FREY, Friedrich Hermann. See GREIF, MARTIN.

FREY, Heinrich, German anatomist and zoologist: b. Frankfort-on-the-Main, 15 June 1822; d. Zürich, 17 Jan. 1890. He began his studies at Bonn in 1840, and continued them up to 1845 at Berlin and Göttingen, when he took the degree of doctor in medicine and at the last-named university became assistant professor of physiology. In 1848 he was appointed professor of histology and comparative anatomy at Zürich, and professor of zoology at the Polytechnic Institute there. He wrote several volumes on histology and microscopy which are among the leaders in their special field. They include 'Histologie und Histochemie des Menschen' (5th ed., 1876; English trans. 1874); 'Das Mikroskop und die mikroskopische Technik' (8th ed., 1886; English trans. 1874); 'Grundzüge der Histologie' (3d ed., 1885). He was considered one of the first microlepidopterologists of Germany. He wrote a 'Text-Book of Zootomy' (1847); 'An Introduction to the Study of Invertebrates' (1847); and an elaborate account of the lepidoptera of Switzerland.

FREY, Joseph Samuel Christian Frederick, American clergyman: b. Mainstockheim, Bavaria, 1773; d. Pontiac, Mich., 1850. He was of Jewish parentage, and at an early age began the study of Hebrew theology, and became a reader in the synagogue in 1794. He was converted to Christianity in 1798, went to England and from 1800 to 1807 was a missionary of the London Missionary Society among the Jews of England. He came to America in 1816 and two years later became pastor of the Mulberry Street Congregational Church, New York. He established the American Society for Improving the Condition of the Jews in 1820. In 1827 he joined the Baptist ministry, and during the next 10 years held several pastorates in that Church. From 1837 to 1840 he labored in Europe for the American Society for the Conversion of the Jews, and met with little success. He returned to America in 1840 and settled at Pontiac, Mich., where he became instructor in Hebrew in the University of Michigan. He published 'My Life' (1809); 'Judah and Israel' (1837); 'Hebrew-English Dictionary' (1839); 'Hebrew Grammar' (1840); 'Joseph and Benjamin: A Series of Letters on the Controversy between Jews and Christians' (2 vols., 1842).

FREYBURG. See FREIBURG.

FREYCINET, frā-sē-nā, **Charles Louis de Saulces de,** French statesman: b. Foix (Ariège), 14 Nov. 1828. He was trained as an engineer, and held several important appointments, and rendered notable service when associated with Gambetta in the War Department in 1871. He was elected to the Senate in 1876, and became Minister of Public Works in the following year. He was Minister of Foreign Affairs and president of the Council 1879–80, and these posts he held on several subsequent occasions. In 1888 he became Minister for War, and continued to hold that office for five years, during two of which (1890–92) he was also Premier. In 1893 he had to resign owing to the Panama scandals. As head of the War Department he did much to strengthen and develop the French army. In 1898–99 he again held the post of Minister of War. He is the author of several important works on engineering and sanitation, and of 'La Guerre en Province pendant le Siège de Paris' (1872); 'Essais sur la philosophie des Sciences' (1895); 'La Question d'Egypte' (1905). In 1914 he published two volumes of memoirs. In 1890 he was elected to the French Academy.

FREYCINET, Louis Claude Desaulses de, French naval officer and navigator: b. Montélimart, Drôme, 7 Aug. 1779; d. 1842. He entered the navy in 1793, and saw service against the English and Spanish in 1795. With his brother Louis Henri he joined Baudin's expedition in 1800 for the exploration of the south and southwest coasts of Australia in the *Naturaliste* and *Géographe*. This expedition traversed much of the ground explored by Flinders. He returned to Paris in 1805 and received an appointment in the Department of Marine Maps and Charts, with the assignment to make maps of the territory he had covered with the Baudin expedition. He went to Rio de Janeiro in 1817 in command of the *Uranie* to take a series of pendulum measurements. He was accompanied by Arago, and his expedition was in reality part of a general plan of investigations in ethnology, geography, astronomy, meteorology, terrestrial magnetism and for collecting natural history specimens. On this voyage Freycinet visited Australia, Marianne, Hawaii, other Pacific islands, and South America. The *Uranie* was lost but nevertheless Freycinet returned to France with several splendid collections. He published 'Voyages de découverte aux terres australes pendant les années 1800–04' (2d ed., 1825); and 'Voyage autour du monde entrepris par ordre du roi' (13 vols., 1824–44). He also published some scientific memoirs and was one of the founders of the Geographical Society of Paris.

FREYLINGHAUSEN, frī'ling-how'zen, **Johann Anastasius,** German theologian and religious poet: b. Gandersheim, 1670; d. 1739. He was educated at Jena, where he studied theology. In 1695 he removed to Halle where he was assistant to Francke, and later became pastor and director of the Pedagogical Institute. He published several important works of theology, but his fame rests chiefly on the many hymns he composed and edited. His 'Compendium der christlichen Lehre' appeared in English in 1804 under the title 'Abstract of the Whole Doctrine of the Christian Religion.' The 'Grundlegung der Theologie' (14th ed., 1744) long remained a very popular work. Of his hymns the principal may be found in the collections 'Geistreiches Gesangbuch' (1714), containing 683 hymns, and 'Neues geistreiches Gesangbuch' (1718), containing 798 hymns. His hymns were very popular in Protestant Germany and have been republished many times.

FREYTAG, frī'täg, **Gustav,** German novelist, journalist and critic: b. Kreuzburg in Silesia, 13 July 1816; d. 30 April 1895. He was a son of the physician and burgomaster, Gottlob Ferdinand Freytag, a man of much dignity and reserve. His mother was cheerful, sympathetic and helpful. Seiler, one of his biographers, compares Freytag's home life with that of the young Goethe. It is certain that he never suffered any privations and had all possible assistance in obtaining a good education. At the age of 13 he entered the gymnasium at Oels. Here he developed a taste for wide reading. Of foreign authors he became interested chiefly in Walter Scott and James Fenimore Cooper. He himself has given testimony to the influence these writers had upon him during the formative period of his life.

In 1835 he left the gymnasium to enter the University of Breslau with the intention of devoting himself to the study of the classics. He came in touch here with Hoffman von Fallersleben who introduced him to the wonderland of Germanic antiquities. In the fall of 1836 he went to the University of Berlin where he attended the lectures of Karl Lachmann. According to Freytag's own account Lachmann was an inspiring teacher, and his lectures on the 'Nibelungenlied' and the history of the literature of the Middle Ages became the basis of Freytag's later studies in this field. In 1838 Freytag was granted the degree doctor of philosophy by the University of Berlin. In 1839 he established himself as lecturer (*Privatdozent*) in the German language and literature at the University of Breslau, but resigned the position after only a few years, to devote himself entirely to literary studies. In 1848 he moved to Leipzig, having purchased in company with Julian Schmidt, the literary historian, the political and literary journal known as the *Grenzboten*. They announced their editorial policy as liberal in politics and also in literature, but opposed to the strongly radical and revolutionary ideas of «Young Germany.» Freytag was connected with this journal almost during the entire period from 1848–70. All his important writings, except 'Die Ahnen' and 'Erinnerungen aus meinem Leben,' were published in this period. In 1870 he was summoned by the Crown Prince, later Emperor Frederick III, to his headquarters in the Franco-Prussian War as correspondent. The 10 years following he devoted to the writing of the series of historical novels, 'Die Ahnen.' The latter part of his life was spent in Wiesbaden and Siebeleben. After 1880 he took little interest in political and literary matters.

As a journalist he wrote many articles of more than passing value, but as a literary man his fame rests chiefly on four works: 'Die Journalisten' (1853), 'Soll und Haben' (1855), 'Bilder aus der Deutschen Vergangenheit' (5 vols., 1859–67) and 'Die Ahnen' (1872–80). 'Die Journalisten' is one of the most interesting of German comedies and is keenly enjoyed even to-day when it is well performed. The most successful character of the play is Konrad Bolz, a cheerful journalist, who feels the discords of his time, but whose genial nature makes the best of all situations. The acting qualities of the play are largely due to a brilliant dialogue. 'Soll und Haben' was an epochmaking novel in which Freytag ennobled the routine and toil of daily life. He conceived it to be the duty of writers in those trying times of political turmoil and social unrest to hold up before the people an example of their ability for efficient work. In its genial humor this novel shows the influence of Dickens. Its success was phenomenal, 64 editions having appeared up to 1906. The present-day reader, however, usually finds it somewhat tedious. 'Bilder aus der Deutschen Vergangenheit' is a series of descriptions of German life from its beginnings to recent times. In its clear style this work is a masterpiece of German prose. Freytag sketches the life in castle and cloister, the exploits of the knights of the Middle Ages, the intellectual ferment of the Reformation, the degradation of the Thirty Years' War, the rise of the Prussian state, and finally the wars of liberation of 1813–15. 'Die Ahnen' is a cycle of eight novels in which Freytag made a poetical transcription of his 'Bilder aus der Deutschen Vergangenheit.' The artistic value of these writings varies, but upon the whole the series is attractive and has the distinction with the 'Bilder' of setting forth the unity and continuity of German life. Another of his novels, 'Die Verlorene Handschrift' (1864), is not quite on the same plane as 'Soll und Haben.' The characters are somewhat artificial; they have not developed from life itself, but show the hand of the conscious imitator of real art. The humor, too, is at times forced and the language is not always spontaneous and free from mannerisms. Freytag's theoretical work, 'Die Technik des Dramas' (1863), indifferently translated by McEwan, Chicago 1894, is based upon the classical German drama. It is instructive and stimulating and states the fundamental dramatic laws clearly, but it should not be misused by trying to derive from it absolute rules that must invariably be followed. Other works of lesser importance are the dramas 'Die Brautfahrt, oder Kunz von der Rosen' (1841); 'Die Valentine' (1847); 'Graf Waldemar' (1850); and 'Die Fabier' (1859). 'Karl Mathy,' a biography, was published in 1870 and 'Lebenserinnerungen' in 1886.

At his death in 1895 Freytag was enjoying great popularity and his popularity has not waned up to the present day. He was not a genius, unless we define genius as «an infinite capacity for taking pains.» He himself early recognized that he lacked the divine spark, but undaunted he made the most of the talent he possessed. «German poetry, German scholarship and German patriotism,» as Erich Schmidt says, «were in Freytag fused into an indissoluble unity.» (See DEBIT AND CREDIT; JOURNALISTS, THE). Consult Collected Works, 22 vols., 1886–88; Lindau, Hans, 'Gustav Freytag' (Leipzig 1907); also Seiler, Friedrich, 'Gustav Freytag' (Leipzig 1898), and Schmidt, Erich, 'Dem Andenken Gustav Freytags' (in 'Deutsche Rundschau' (Vol. 83, pp. 453–464); republished in 'Charakteristiken,' 2d series, Berlin 1901).

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FRIAR, from the French *frère*, Latin *frater*, signifying brother, is a name common to the male members of any religious order. Thus the Capuchins were originally called Friars Hermits Minor, and the Observants, Friars Observants. The term, however, is more exclusively applied to those of the mendicant orders; of which the four chief were the Dominicans (Black Friars), Franciscans (Gray), Carmelites (White), and Augustinians. The most important lesser orders of friars are the Minims; the Third Order Regular of Saint Francis; the Capuchins; the Discalced Carmelites; the Discalced Trinitarians; the Order of Pennance or Scalzetti. Consult Creighton, M., 'Historical Lectures' (1904); Heimbucher, N., 'Die Orden und Kongregationen' (Paderborn 1907); Hélijot, P., 'Histoire des Orders Monastiques réligieux, etc.' (8 vols., Paris 1714–19); Monahan, W. B., 'Monks and Friars' (in *Associated Architectural Societies, Reports and Papers,* Vol. XXVII, p. 419, Lincoln 1904); Wietz, F. K., 'Abbildungen Sämtlicher Geistlicher Orden, etc.' (2 vols., Prague 1821).

FRIAR BACON, popular title of Roger Bacon. It is employed in a play of 1594 by Robert Greene under the title 'The Honorable History of Friar Bacon and Friar Bungay.' Thoms' 'Early English Prose Romances' (London 1828) contains the reprint of a prose work of 1627, entitled 'The History of Friar Bacon.'

FRIAR-BIRD, a familiar woodland bird of Australia, of moderate size, with brownish-drab plumage, head and neck bare of feathers and a cowl-like neck-ruff. They frequent tree-tops, possess considerable strength and boldness, and, when injured, have been known to inflict severe wounds with their strong claws and beaks. It is an aberrant form of honey-eater (*Meliphagidæ*); some 16 species, all of the Malayan and Australian regions, are grouped in the genus *Philemon*, of which the present species is named *P. corniculatus*, in reference to a horny excrescence upon the base of the culmen of the beak. Its loud cries and other peculiarities have given it many local names, such as «monk,» «leatherhead,» «poor soldier,» «pimlico» and «four o'clock.» Consult Gould, J., 'The Birds of Australia' (7 vols., London 1848); Le Souëf, W. H. D., 'Wild Life in Australia' (Christchurch 1907).

FRIAR'S BALSAM, popular term for the compound tincture of benzoin. It is often applied to a similar preparation, balsamum traumaticum. Friar's balsam is extensively used as a dressing for wounds and ulcers, having the properties both of a stimulant and of an antiseptic.

FRIAS, frē'äs, **Tomás**, distinguished Bolivian statesman: b. Potosí 1805; d. 1884. He was Secretary of State during several administrations, and in 1872, on the death of Morales, was chosen provisional President. He was elected to the vice-presidency in 1873 and in the following year succeeded to the presidency on the death of President Ballivian. His administration passed quietly, undisturbed by internal dissension, and was marked by many progressive measures. His term of office expired in 1877 and in 1879 he became Minister to France. Because of his progressiveness and integrity he is regarded as one of the greatest statesmen of South America.

FRIBOURG, fri'boorg, or **FREIBURG**, Switzerland, canton in the western portion of the country, bounded on the north and east by the canton of Bern, and on the south and west by Vaud, on the northwest by Lake Neuchatel. Its area is 646 square miles. The southern and eastern portions of the canton are elevated and the northwestern portion forms part of the basin of Lake Neuchatel. The Broye and the Saane are the principal rivers. Wood for export is obtained in the mountain forests, which yield also quantities of limestone, gypsum and pitch coal. Grain, potatoes, tobacco, fruit and grapes are the general crops grown on the productive area, which is 88 per cent of the total. Dairy products, black cattle and draft horses form considerable export items. The manufactures include watches, cigars, tobacco, paper, glass and woolens. Straw plaiting and tanning form the leading industries. French is the official language, but legislative measures are published in German also, since the canton is on the dividing line between the French and German-speaking populations of Switzerland. Roman Catholicism is the prevailing religion. Educational facilities are many, comprising the University of Fribourg, a seminary, college, industrial schools and many secondary and elementary schools. The ancient inhabitants were the Helvetii, who were in time displaced by the Alemanni and the Burgundians. The Franks took hold of the country in the 6th century, and in 1032 it became a part of the Holy Roman Empire. At the time of the Reformation Protestantism was not allowed to spread here. The French conquered the land in 1798 and held it until 1814. The canton is the most conservative in Switzerland, and popular rights are still rather restricted. The government is administered by a Grand Council, chosen by popular vote, and seven representatives are chosen for the National Council. Pop. 139,200. Consult Berchtold, 'Histoire du canton de Fribourg' (Fribourg 1841–45); and Marrot, 'Chronique du canton de Fribourg' (ib. 1878).

FRICK, Henry Clay, American manufacturer: b. West Overton, Pa., 19 Dec. 1849. He began business life as a clerk for his grandfather, a flour merchant and distiller, and later embarked in a small way in the coke business. He was president and since 1897 has served as chairman of the board of directors of the H. C. Frick Coke Company, now the largest producer of coke in the world, operating nearly 40,000 acres of coal and 12,000 coke ovens, with a daily capacity of 25,000 tons. He came into public notice by his vigorous management during the famous strike at Homestead, Pa., in 1892, when he was several times shot and stabbed by one of the strikers. In 1889–92 he was chairman of the board of the firm of Carnegie Brothers, and later chairman of the board of managers of the Carnegie Steel Company. He is a director of the Pennsylvania Railroad Company, the Atchison, Topeka and Sante Fe, the Chicago and Northwestern railways, the United States Steel Corporation, the Norfolk and Western Railroad Company, etc.

FRICTION, in mechanics, is the adhesion or degree of adhesion of contacting surfaces; the resistance which opposes the slipping or sliding of two bodies in contact. In an active sense, it is the rubbing together of things; in a passive sense, it is the tendency to adhere or stick, presented by bodies in contact, whether moving or at rest. Gritty substances and sticky substances between surfaces tend to increase friction; oils, fluids and gases interposed tend to reduce friction. The degree of friction between surfaces is determined by: (1) the weight or pressure with which they contact; (2) the extent or surface of area in contact; (3) the degree of roughness or smoothness of the contacting surfaces; (4) the speed at which the surfaces move; (5) the extent or kind of lubrication employed. The angle of friction is the maximum slope at which one body will rest on another without the upper one sliding off by gravity. Efforts have been made to tabularize the angle of friction of different contacting surfaces, but so many conditions are involved that in practice such tables are worthless. It is generally true, however, that at 45 degrees almost all straight surfaces will slip and smooth lubricated surfaces can be depended upon to slip at half that angle. A block placed on a flat, smooth surface can be moved by a force equaling two-fifths of its weight.

When friction is considered with reference to two bodies at rest, it is called static friction. Instances of static friction in machinery are noticeable in friction couplings or friction discs, consisting of two discs placed close together, just out of contact, one of which rotates while the other is stationary, but when both discs are tightly pressed together by the action of a lever, they rotate together, as if they were one. Friction between bodies in motion is called kinetic friction. This exists in the journal or bearing of an axle, on the working surface of cams, etc., in machinery; and machine designers as well as operators of machines should keep down such friction all they can, as it uses power to no good end.

Static friction is measured by the force that is required to just cause one body to move upon the other, when the two are pressed together by a certain definite pressure; and the ratio of this force to the pressure with which the bodies are held in contact is called the «coefficient of statical friction.» Kinetic friction is measured by the force that is required to maintain one of the bodies that are in contact, in a state of uniform motion with respect to the other one; and the ratio of this force to the force with which the bodies are pressed together is called the «coefficient of kinetic friction.» The coefficient of static friction between two given substances may be determined by causing a weight composed of one of the substances to rest upon a smooth plane composed of the other substance. If the plane is nearly horizontal, the weight will not slip upon it; but by increasing the angle of inclination, a position will be found for the plane, such that the weight is just on the point of sliding. The angle that the plane then makes with the horizontal is called the «angle of repose» of the pair of substances of which the plane and the weight are composed; and it may be shown by the elementary principles of mechanics that the coefficient of statical friction for these substances is numerically equal to the natural tangent of the angle of repose.

Rolling friction presents different characteristics from rubbing or static friction. It arises from the contact between a stationary surface and a rolling wheel, sphere or cylinder, or between two rotating surfaces. The tractive effort required to draw a cart on a smooth level road is about one-thirtieth of the weight of cart and load. A carriage wheel running on the ground is an instance of rolling friction, while the friction in the axle box is rubbing friction if the bearing be a plain one, or rolling friction if ball-bearings or roller-bearings are employed. Some have thought there was no friction between the steel balls and the raceway of a ball-bearing, but it is obvious that the weight or pressure produces static friction and that the imperfections of the surfaces, even though very minute, must always exist and there is almost sure to be some dust or grit in such bearings at some time, hence rolling friction has to be figured on by machine designers, even in the best bearings, though it may be trifling, as in the ball-bearings of a typewriter. Sliding friction is a term used as opposed to rolling friction and is identical with kinetic or rubbing friction, except that it suggests surfaces designed to slide easily.

To reduce friction in the moving parts of machinery, the parts contacting are made smooth, and their area or surface is kept small, as in roller-bearings and ball-bearings. (See BEARINGS). Provision is also made for some form of lubrication, the common plan being to bore small holes leading to the bearing or other point of friction and supply such holes with oil occasionally. In large bearings grooves are often cut diagonally in the surface of shafts to carry the oil to the entire surface. The principle of lubrication is the placing of a film of slippery substance between rubbing surfaces not so slippery. Oil is the most common lubricant and thin oil is used on light-running machinery and heavy, thick oil or grease on heavy machinery where the weight might tend to drive out or use up the light oil quickly. Water is sometimes employed, being cheaper. Graphite is an efficient lubricant, employed in cases where it is difficult to retain oil, as on a bicycle chain. In kinetic friction between surfaces that are smooth and well lubricated, the results depend far more upon the nature of the lubricant than they do upon the nature of the rubbing surfaces; and they are also greatly dependent upon the method by which the lubricant is applied. When a journal is lubricated by means of an oily pad placed underneath it, the friction may be more than six times as great as when the same journal is run in a bath of oil. Speed also has a great influence upon the amount of friction developed.

Early books on mechanics and engineering contained assumed laws of friction which were quite erroneous and are now disregarded. There is no method of determining in advance the actual friction in a mechanism, because all the conditions are never certainly known, and some of them are subject to change daily or hourly. In a cotton-spinning frame, for instance, the cotton bands that drive the spindles tighten up through shrinkage on a damp day, causing undue pressure on the bearings and often doubling the friction of the machine. The most nearly frictionless machine ever constructed is doubtless the Emery testing machine, which is employed for testing great bars of steel, as by pulling them apart. Large sizes of this machine will exert a pull of 500,000 pounds and, of course, this involves tremendous strain on the parts of the machine, and when the piece tested is pulled apart and broken and the strain is thus suddenly released, the reaction of the parts strained is equal to the breaking strain and would rack the machine terribly were not almost frictionless devices introduced. These are the «weighing-heads,» constructed on the principle of hydraulic weighing machines. The blow of reaction is received by a plunger bearing against a body of water, and the shock is absorbed by the water without injury to the machine. It would appear that nature makes frictionless machinery, for the earth and planets revolve in a medium in space so tenuous that no evidence of friction is observable. Were friction present, it would show itself in retardation of rotation as well as as orbital revolution. For the internal friction of liquids see VISCOSITY.

CHARLES H. COCHRANE.

FRIDA, frē'dä, **Emil Bohusch,** Czech poet and dramatist: b. Laun, Bohemia, 1853; d. 1912. He received his education at Prague, and in 1893 became professor of literary history at the Czech university of that city. He became a member of the Austrian House of Peers in 1901. He wrote comedies, tragedies, epics, several novels and made many translations from the best Continental writers. He has been likened by some to Victor Hugo. Much of his work has been translated into German, and in English his one-act play 'At the Chasm' appeared in *Poet Lore* (Vol. XXIV, 1913).

FRIDAY, a savage in Defoe's 'Robinson Crusoe.' Crusoe saved his life on a Friday, named him after the day and was faithfully served by him.

FRIDAY, the sixth day of the week, so named from the Anglo-Saxon *Frigedag*, the day of Friga, the wife of Odin and the Teutonic goddess of love. The Anglo-Saxon corresponds to the Lat. *Dies Veneris,* day of Venus, whence the French *Vendredi,* Friday. Its religious associations are varied. According to the Mohammedans it was the day when Adam was created, entered Paradise, was expelled therefrom, the day of his repentance, of his death and is to be the day of resurrection. It is the Moslem «day of assembly» or sabbath. As the day of Christ's crucifixion it is generally observed in the Greek, Latin and other Christian episcopal churches as a fast day, except when Christmas falls on a Friday, and is especially observed on Good Friday (q.v.). From the same cause, also, it is regarded among the superstitious as an unlucky day, and was long associated in the public mind with the execution of criminals sentenced to death, which usually took place on Friday and was commonly called hangman's day.

FRIDAY CLUB, The, a social club founded by Sir Walter Scott in 1803. Its rendezvous was at Fortune's Tavern. For list of its members see Lockhart's 'Life of Scott' (Vol. II, Edinburgh 1850).

FRIDOLIN, or **FRIDOLD, Saint,** Christian missionary of the 6th century, known as «The Apostle of Allemania.» Our knowledge of him is contained in the life by Balther, written in the 10th century. He labored in Ireland, where he was born, in Poitiers and in the island of Säckingen in the Rhine. He is the patron saint of Glarus, Switzerland, and is represented on its coat of arms. He is commemorated in the ecclesiastical calendar on 6 March. Consult the life by Balcher in Mone's 'Quellensammlung der badischen Landesgeschichte' (Vol. I, Carlsruhe 1845); Heber, 'Die vorkarolingischen Glaubenshelden' (Göttingen 1867); Heer, 'Sankt Fridolin, der Apostel Alemanniens' (Zürich 1888).

FRIED, frēd, **Alfred Hermann**, German peace advocate: b. Vienna 1864. He removed to Berlin in 1883, where he established a bookstore. After 1891 he devoted himself to the peace movement, founded the German Peace Society in 1892 and edited the *Friedenswarte*. He was joint-winner of the Nobel Peace prize in 1911. He has published 'Friedenskatechismus' (1895); 'Tagebuch eines zum Tode Verurteilter' (1898; Eng. trans., 1899); 'Lasten des bewaffneten Friedens und des Zukunftskrieg' (1902); 'Handbuch der Friedensbewegung' (1905; 2d ed., 1911); 'Die moderne Friedensbewegung' (1906); 'Pan-Amerika' (1910); 'Der kranke Krieg' (1910); 'Der Kaiser und der Weltfrieden' (1910; Eng. trans., 1912).

FRIED Oskar, German composer: b. Berlin, 10 Aug. 1871. His early musical education was scanty, and was obtained at intervals; he played meanwhile in obscure orchestras. Humperdinck noticed him at Frankfort and from him Fried received his first systematic instruction in composition. Later he studied counterpoint at Berlin under Scharwenka. His first success was 'Das trunkene Lied,' which appeared in 1904. From 1907 to 1910 he conducted the *Sternscher Gesangverein* of Berlin, and in the latter year established a symphony orchestra. He is famed as a successful choral and orchestral leader. He has written a prelude and double fugue for string orchestra, two choral works, andante and scherzo for wind instruments, and several songs. Consult Bekker, P., 'Oskar Fried: Sein Werden und Schaffen' (Berlin 1907); Leichentritt, H., 'Oskar Fried' (Leipzig 1906).

FRIEDEL, frē'děl, **Charles**, French chemist: b. Strassburg 1832; d. 1899. He studied under Pasteur in his native town and continued his scientific education at Paris, entering the laboratory of Wurtz. In 1869 he was graduated with two remarkable theses, one in organic chemistry and one in mineralogy which at once brought him to the notice of men of science. He was made instructor at the Ecole Normale in 1871, and in 1876 became professor of mineralogy in the Sorbonne. In 1878 he became member of the Institute in succession to Regnault. He eventually succeeded Wurtz (1884) as professor of organic chemistry and director of the research laboratory in the Sorbonne, a position he maintained till his death. The Ecole de Chemie, in connection with the University of Paris, was organized by Friedel in 1892. His contributions to synthetic mineralogy and to industrial chemistry have been of the greatest and most far-reaching importance. His researches are recorded by him in 254 original memoirs and entitle him to a place among the foremost scientific men of the 19th century. His name is especially connected in association with James Mason Crafts (q.v.) with the synthetic method known as the Friedel and Crafts reaction (q.v.). He published, in addition to textbooks on mineralogy and crystallography, 'Cours de chimie organique professé a la faculté des sciences de Paris' (1887).

FRIEDEL AND CRAFT'S REACTION, in chemistry, a synthetic method discovered by the French chemist, Charles Friedel, in conjunction with James Mason Craft. This discovery revealed the action of various chlorinated compounds on hydrocarbons in the presence of aluminum chloride. A vast number of varying organic compounds may thus be produced in any ordinary quantity, for example, triphenyl methane is a commercial compound, necessary to the production of valuable dyes; by Friedel and Craft's Reaction process it can be produced rapidly and cheaply in any quantity required.

FRIEDELITE ($H_7(MnCl)Mn_4Si_4O_{16}$), an acid silicate of manganese, containing some chlorine, and crystallizing in the rhombohedral system, but also occurring massive. It is rose-red in color, transparent or translucent and is found in a manganese mine at Adervielle, France. It was named after the French chemist and mineralogist Charles Friedel (q.v.).

FRIEDENTHAL, frēd'ĕn-täl, **Karl Rudolf**, German statesman: b. Breslau 1827; d. 1890. He received his education at Breslau, Berlin and Heidelberg. He was elected to the Reichstag in 1867 and aided in founding the Free Conservative party. He was present as a member at the Versailles conference during the Franco-Prussian War at which the constitution of the German Empire was framed. In 1875–80 he held the portfolio of Minister of Agriculture and afterward was elevated to the House of Lords. He laid the foundations for the economic development of modern Germany.

FRIEDENWALD, Herbert, American author and editor: b. Baltimore, Md., 20 Sept. 1870. He was educated at Johns Hopkins University where he was graduated in 1890, and at the University of Pennsylvania from which he received the degree of D.Ph. in 1894. He was chief of the division of manuscripts of the Library of Congress from 1897 to 1900; edited the *American Jewish Year Book* from 1908 to 1913; was secretary of the American Jewish Committee from 1906 to 1913, and is an officer of the American Jewish Historical Society. He has written 'The Continental Congress'; 'The Journal and Papers of the Continental Congress'; 'Material for the History of the Jews in the British West Indies'' (1897); 'Some Newspaper Advertisements of the Eighteenth Century' (1897); 'Historical Manuscripts in the Library of Congress' (1898); 'A Calendar of Washington Manuscripts in the Library of Congress' (1901); 'The Declaration of Independence' (1904); 'Preparedness,' a play (1915); 'Upheaval,' a play (1915).

FRIEDERICIA, frē-dā-rē'sē-ā, **Julius Albert**, Danish historian: b. Copenhagen 1849. He was appointed assistant librarian of the library of the University of Copenhagen in 1891. He is the author of 'Danmarks ydre politiske Historie i Tiden fra Freden i Lybek til Freden i Brömsebro' (1876–81); 'Adelsvoeldens sidste Dage Danmarks Historie fra Christians IV's

Dod til Enevoeldens Indforelse' (1894); 'Revolutionen og Napoleon I 1789–1815' (1903); and 'Christian IV's egenhændige Breve,' in collaboration with Bricka (1878–1901).

FRIEDHEIM, frēd'hīm, **Arthur,** German pianist: b. Petrograd 1859. At an early age he showed signs of musical ability. He received the ordinary education of a German youth of the upper classes in the gymnasium and university. He studied under Liszt at Rome in 1880–82, acted as conductor in various theatres for several years and again studied with Liszt at Weimar. He visited the United States in 1890 and there made his début as a pianist. He obtained recognition very slowly owing to his lack of moderation. His execution was so spirited that it rendered his playing colorless, and obscured many other excellent qualities. Through extensive tours in Europe he gradually came to be recognized as the greatest of the Liszt players, and on his return to the United States in 1910 his conquest was immediate. After 1908 he continued to live in Munich. He has written an opera, 'Die Tänzerin,' which was produced at Cologne in 1905, and a concerto in B flat for piano and orchestra.

FRIEDLAND, frēd'länt, **Valentin,** German educator: b. Trotzendorf, Upper Lusatia, 14 Feb. 1490; d. Goldberg, Silesia, 26 April 1556. He was educated at the University of Leipzig, was instructor at the Görlitz School for a time, but was obliged to resign in 1518 because of his sympathy with the doctrines of Luther and Melanchthon. He was appointed rector of the Goldberg gymnasium in 1523 but remained only for a short time; he returned in 1531 and rendered the school one of the most famous in Europe. Its organization was unique for the period, being modeled on that of the Roman Republic, the students having a voice in the administration. Latin became the official language of the school. The buildings were destroyed by fire in 1554 and the school was temporarily installed at Liegnitz pending the erection of a new school building at Goldberg. Friedland died while the building was under construction. Consult the lives by Löschke (Breslau 1856) and Pinzger (Hirschberg 1825).

FRIEDLAND, Prussia, small town 28 miles southeast of Königsberg, in East Prussia, on the river Alle. The Russians under Benningsen were here defeated on 14 June 1807 by the French under Napoleon (q.v.). Pop. 3,029.

FRIEDLAND, Sagan and Mecklenburg, DUKE OF. See WALLENSTEIN.

FRIEDLÄNDER, C. Gottfried Immanuel, German geologist: b. Berlin 1871. He was educated in Berlin, in the Kiel University and the Zürich School of Technology. He traveled extensively in North America, Hawaii and Samoa in 1893–94. In 1896 he visited the Canary Islands, in 1897 Madeira, in 1906 he came to Mexico, revisited Samoa in 1907, traveled in Japan in 1908–09 and in 1912 in the Cape Verde Islands. He made a special study of volcanoes and all his travels were for the purpose of gathering data in regard to this subject. After 1901 he resided in Naples in order to study Mount Vesuvius. He built a volcanological institute there in 1913 and founded the *Zeitschrift für Vulkanologie*. He has written many papers on the relation between the production of diamonds and other precious stones to volcanic action. In 1910 he was a member of the International Geological Congress at Stockholm, where he proposed the establishment of a volcanological institute at Naples.

FRIEDLÄNDER, Ludwig, German classical scholar: b. Königsberg, Prussia, 24 July 1824; d. 1909. He received his education at the Königsberg gymnasium and at Leipzig and Berlin. In 1847 he was appointed privatdozent at the University of Königsberg and in 1858 became full professor there. He retired in 1892 and removed to Strassburg. During his active life he paid considerable attention to Roman archæology and Homeric literature. His most representative work is 'Typical Studies in the History of Roman Manners and Morals' (8th ed., 1910), written in popular style. 'The Remains of Nicanor's Emendations of the Punctuations of the Iliad' (1850); 'Die homerische Kritik von Wolf bis Grote' (1853); 'Analecta Homerica' (1859), constitute him an authority in Homeric criticism. Other works are 'Ueber den Kunstsinn der Römer in der Kaiserzeit' (1852); 'Darstellungen aus der Sittengeschichte Roms, etc.' (8th ed., 1910); the works of Martial (1886); Petronius' 'Cena Trimalchionis' (2d ed., 1906); Juvenal's works (1895).

FRIEDLÄNDER, Max, German musical scholar: b. Brieg, Silesia, 1852. In early life he engaged in commercial pursuits, finally gave up this career, studied singing under Garcia in London and later under Stockhausen at Frankfort. He made his début as a singer at London in 1880, but did not continue long in this field, having become interested in the history of music. He settled in Berlin in 1883, where he came under the influence of Spitta, which led him to pursue original researches in the history of music. The University of Rostock conferred on him the degree of D.Ph. in 1887. He was appointed instructor in the science of music at Berlin University in 1894, becoming professor in 1903. He set about writing an exhaustive biography of Schubert and in pursuing this task discovered over 100 lost songs of the latter and many old folksongs. In 1912 he lectured in the United States. He has published 'Goethe's Gedichte in der Musik'; 'Gedichte von Goethe in den Kompositionen seiner Zeitgenossen,' and 'Das deutsche Lied im 18 Jahrhundert.'

FRIEDMAN, Isaac Kahn, American author: b. Chicago, Ill., 3 Nov. 1870. He was graduated at the University of Michigan 1893. Later he took part of post graduate course in philosophy and English in the University of Chicago. He spent three years in the florist business with his brother, since when he has been special writer on Chicago newspapers and for various magazines. In 1908 he traveled through Japan, China, Korea for the Chicago *Daily News*, contributing articles on sociological and economic topics. He has written 'The Lucky Number' (1896); 'Poor People' (1900); 'By Bread Alone' (1901); 'Autobiography of a Beggar' (1903); 'The Radical' (1907).

FRIEDMANN, Alfred, German poet and novelist: b. Frankfort-on-the-Main, Prussia, 26 Oct. 1845. He received his education at the universities of Heidelberg and Zürich. In 1886 he removed to Berlin and there devoted himself to literary work, producing many novels and works of verse. Among his poems are 'Merlin,' 'Orpheus' (1874); two ballads; 'Biblical Stars' (1875), comprising three idylls; 'Love's Fire Test, Angioletta'; 'Lays of the Heart' (1888). He is the author of many novels, including 'Two Marriages'; 'Suddenly Rich' (1891); 'The Wild Rose' (1893); 'Inez de Castro' (1898); 'Tantalus' (1901); 'Die letzte Hand' (1902); 'Vier Liebhaber der Marquise' (1905).

FRIEDRICH, frēd'rĭн, **Johannes,** German Old Catholic theologian: b. Poxdorf, Bavaria, 5 May 1836. After studying at the universities of Bamberg and Munich he entered the Roman Catholic priesthood in 1859. In 1865 he became professor of theology in the University of Munich. At the Vatican Council, 1869–70, he united with his colleague Döllinger (q.v.) in opposing the dogma of papal infallibility, and when acceptance of the dogma was demanded by the archbishop of Munich of the faculty of the Munich University, he with Döllinger declined and was excommunicated. In 1882, however, he was given another professorship, being transferred by request to the philosophical faculty. He opened in 1874 the Old-Catholic theological faculty at the University of Bern and lectured there for a year. He was one of the leaders in founding the Old Catholic Church, but withdrew from active leadership in 1878 when the Old Catholic Synod voted to allow its priests to marry. Among his many writings are 'Tagebuch während des vaticanishen Concils' (1871); 'Documenta ad Illustrandum Concilium Vaticanum' (1871); 'Zur Verteidigung meines Tagebuchs' (1872); 'Beiträge zur Geschichte des Jesuitenordens' (1881); 'Geschichte des Vaticanischen Concils' (1877–87), and 'Life of Döllinger' (1899–1901).

FRIEDRICH, John, American violin-maker: b. Cassel, Germany, 1858. Having studied violin making under Oswald Möckel, he came to the United States in 1883, and shortly took prominent rank in his calling. In 1893 he obtained the highest award for violins, violas and violon-cellos at the World's Columbian Exposition. He has also made bows of very excellent workmanship, and came to be recognized as an expert in identifying and appraising rare specimens. Four of the choicest specimens of his violins are in the possession of Dr. Frank Waldo of Cambridge, Mass.

FRIEDRICH, Kaspar David, German painter: b. Greifswald, 5 Sept. 1774; d. Dresden, 7 May 1840. He obtained his training under Ruistoop at Greifswald and under Eckersberg at the Copenhagen Acadamy of Fine Arts. In 1795 he settled at Dresden, where he became member and professor of the Academy. He drew his inspiration from scenes on the Baltic, at Rügen and in the mountains of Germany. Of the Romantic school he excelled in depicting nature as seen through the psychologic medium of transitory human moods. Favorite motifs are the gloom of the forest, night scenes with moonlight or storms at sea. Notable among his works are the following: 'Abbey in an Oak Forest on a Winter's Evening'; 'Pilgrim on the Shore,' both in the Castle of Berlin; 'View in the Hartz Mountains'; 'Moonrise by the Sea,' in the National Gallery, Berlin; 'Rest at Harvest Time,' in the Dresden Museum; 'Grave of Hermann (Arminius)' in Hamburg; and 'The Pine Forest,' at Rügen. In 1906 his works drew general attention at the German Centenary Celebration at Berlin.

FRIEDRICH, Woldemar, German painter: b. Gnadau, Saxony, 20 Aug. 1846; d. 1910. He studied in Berlin under Steffeck, and in Weimar under Plockhorst, Ramberg and Verlat. He accompanied the German troops in the Franco-German War, and thence gained material for his illustrations in Daheim and in Hiltl's 'Der französische Krieg von 1870–71' (6th ed., 1891). In 1881 he became professor in the art school at Weimar and in 1885 in the Berlin Academy. He executed decorative paintings in Castle Hummelshain, Weimar; the Weimar gymnasium. Among several other decorative works on a large scale are to be especially noticed 'The Diet of Worms' (1892) in the aula of the gymnasium at Wittenberg, and the two mural paintings, 'Art and Science' and 'Book-trade and Printing' in the Booksellers' Exchange at Leipzig. He also painted a series of aquarelles and numerous genre-works in oils.

FRIENDLY ISLANDS. See TONGA ISLANDS.

FRIENDLY SOCIETIES IN AMERICA. See FRATERNAL SOCIETIES IN AMERICA.

FRIENDLY SOCIETY, the general name for English benefit associations, usually founded by the working classes for purposes of self-help, which have become mostly mutual insurance societies. They originated with the mediæval guilds and for a long time maintained no benefit funds but made grants to numbers in distress. The benefits are generally for sickness and funeral expenses. Some maintain superannuation funds, others offer endowments, insurance for shipwrecks, loss of working appliances or tools, convalescent homes, widows' and orphans' funds, homes for the aged, and relief for the unemployed. The local societies with their social features are giving way to strongly centralized bodies, with no social union, on a purely business basis, the dues being paid through agents or by mail. The affiliated orders, including the temperance societies, constitute an important portion of the friendly societies; they are democratic social centres, many are of an educational character, and include the pick of the English working classes and many from the lower strata of the middle class. Of the societies for women the United Sisters' Friendly Society is perhaps the most important. Considerable reforms have been effected by legislation providing a legal status and supervision. In 1910 there were 31,469 societies registered under the Friendly Societies Act of 1896 (amended 1908) and of these 29,425 submitted reports giving a membership of 14,-507,000 and funds aggregating $314,330,000. The Hearts of Oak Benefit Society and the Rational Aid and Burial Association are the largest centralized societies. Among the leading affiliated are the Ancient Order of Foresters and the Independent Order of Foresters.

These societies have had a very beneficial effect on the English working man, but they did not reach the very poor and helpless, who have been provided for to a degree under the National Insurance Act. (See OLD-AGE PENSIONS). Consult Baernreither, 'English Associations of Working Men' (London 1893); Fuller, 'The Law Relating to Friendly Societies' (3d ed., ib. 1910); Wilkinson, 'The Friendly Society Movement' (ib. 1886); id., 'Mutual Thrift' (ib. 1891); the *Nineteenth Century,* No. 45,891.

FRIENDS, The Religious Society of. The Religious Society of Friends, commonly called Quakers, had its origin in England about the middle of the 17th century, and was largely the result of the ministry of George Fox, who is often called its founder.

Early History.— George Fox, the son of a weaver, was born at Drayton, in Leicestershire, 1624, and began his public preaching about the year 1648. His spiritual views and practical application of Christian doctrines met a ready response in many pious persons (both Churchmen and Dissenters), and bitter opposition from others whose practices they condemned. His followers increased rapidly, and were known as «Children of Light,» «Children of Truth,» and «Friends of Truth»; finally adopting the name «Religious Society of Friends.» Among them were many itinerant preachers; Fox in his journal (1654) says, above 60 in number. From the first imprisonment of Fox in 1649 to 1687 Friends were the objects of almost continuous persecution. In 1656 Fox computed there were seldom less than 1,000 in prison. Between the years 1661 and 1697, over 13,000 Friends were imprisoned in England, 198 were transported as slaves and 338 died in prison or of wounds received in assaults while attending meetings. These persecutions were upon various pretexts, as, the refusal to pay tithes, to swear or to remove the hat; for preaching in public places; as disturbers of public worship, for speaking in «churches» (a practice then not uncommon); and as Sabbath breakers, for traveling to their meetings on the day called the Sabbath. Many were apprehended for keeping an unlawful assembly under the Conventicle Act. Scotland, Ireland, the Continent and America were early visited by their ministers.

The first to arrive in New England were two women, Ann Austin and Mary Fisher, who came to Massachusetts from Barbados in 1656. After five weeks' imprisonment and much cruel treatment they were sent back. Stringent laws were promptly enacted by that colony to prevent others from coming and owners of vessels from bringing them. Regardless of the cruel penalties of these laws, the Quakers continued to arrive and suffer their infliction. In numerous instances delicate women were «stripped naked from the middle up, tied to a cart's tail and whipped through the town» and thence through other towns. Four — one a woman — were hanged on Boston Common. Nevertheless they increased in numbers and spread to adjoining colonies.

The first Friends in New Jersey settled along the Raritan River in 1663. In 1677 over 200 came to this province and founded Burlington. William Penn joined the society in 1667. In 1681 he and several other Friends purchased East New Jersey, and in the same year Penn obtained from the Crown the grant of Pennsylvania. A few Friends were in the province before Penn acquired it, and two shiploads came in the fall of 1681. The next year Penn himself came with others, and in less than three years the colony had a population of 7,000. For a period of 70 years, and so long as the influence of Friends predominated, there were no conflicts with the Indians. At an early date the society cleared itself of human slavery. Friends began to protest against it as early as 1688, and for nearly 100 years the agitation was continued, until «in the year 1787 there was not a slave in the possession of an acknowledged Quaker.» This was largely due to the labors of John Woolman, a minister in New Jersey, whose journal has a literary reputation.

Organization and Discipline.— Fox and his co-laborers did not have an outward organization as an object. The organization and discipline were progressively developed. The first disciplinary meetings established were held monthly and were in a sense congregational. Some were held as early as 1656, but the practice does not appear to have become general before 1666. The first yearly meeting appears to have been held in 1656, the first in London in 1668, but it was not held there regularly until 1672. The first yearly meeting in America was held in Rhode Island in 1661. Monthly, quarterly and yearly meetings have geographical boundaries; and monthly meetings are subordinate to quarterly, and these to the yearly meeting, which is the source of discipline, and final judge of all questions. At stated periods monthly meetings appoint a few of their number as «Overseers,» whose duty it is to have a loving oversight of the members. Men and women hold separate meetings for business, although some subjects are jointly considered. Of late years the practice of separate meetings has largely been discontinued. Elders are men and women chosen out of the body as «Friends of solid judgment, prudence and experience,» to sit with the ministers and to advise, encourage or caution them as seems needful. Persons — men or women — who speak and pray in public to the satisfaction of the members are, in due time, publicly acknowledged as ministers, or those in whom the body recognizes the «true gift.» Such recognition does not confer upon them any new powers or authority. All members are embraced in a set of «Queries» which are answered, some quarterly — others annually, by meetings for discipline. These have reference to love and unity; attendance upon meetings; consistency in speech, behavior and apparel; oaths, military service and fraudulent business; moderation in trade and living, and just payment of debts; encouragement of a stated or paid ministry; care of the poor and education of children; and keeping records of births, deaths and marriages. (The answering of «Queries» has been discontinued in many meetings). Meetings have no presiding officer. In those for business a clerk is appointed, whose duty is to gather and record the sense or judgment of the meeting as expressed. No question is settled by a majority and no vote is taken. Christ is recognized as «the head over all things to the church.»

Distinguishing Views.—In the essential doctrines of the Christian religion Friends were in accord with their fellow Christians. The principal points in which they differed were:

1. Immediate Divine Revelation. Barclay ('Apology') says: «Nothing is less minded and more rejected by all sorts of Christians

than immediate divine revelation; insomuch that once to lay claim to it is matter of reproach." Again, "He that affirms himself so led (by the spirit of God) is, by the pretended orthodox of this age, presently proclaimed an heretic." Fox (Journal) says: "I saw that Christ had died for all men, and had enlightened all men and women with his divine and saving light. I was commanded to turn people to that inward light, spirit and grace, by which all might know their salvation and their way to God." Friends believed that this inward saving light of Christ was universal and came to both heathen and Christian.

2. Worship and Ministry. Barclay ('Apology') says: "All true and acceptable worship to God is offered in the inward and immediate moving and drawing of his own spirit. All other worship, praises, prayers and preachings, which man sets about in his own will, at his own appointment, and can begin and end at his pleasure are but superstitious will-worship." Again, "As our worship consisteth not in words, so neither in silence as silence; but in an holy dependence of the mind upon God: from which dependence silence necessarily follows in the first place, until words can be brought forth which are from God's spirit." Hence silence is the basis of meetings for worship, which can be, and often are, held without a minister or any vocal service. Neither ministers, nor others, are supposed to break this silence without an immediate opening of a subject, and a sense that the Lord requires the delivery of the message revealed. No special training or educational qualifications are considered necessary for the ministry, and no consistent "Quaker" minister accepts pecuniary compensation for services in that capacity. Accepting literally the command of Christ to his apostles, "Freely ye have received, freely give." Friends refuse to pay tithes or in other way to contribute to the support of a paid ministry.

3. Sacraments. Sacraments require the services of a priest or minister. Friends denied this necessity, rejecting all types and outward ordinances. They taught that the only saving baptism was that of the Holy Spirit, and that the true communion was not partaking of bread and wine, but the spiritual "eating of the flesh and drinking of the blood" of Christ. They held that marriage was the Lord's joining of man and woman, and, therefore, was not performed by man — men were but witnesses.

4. War, Oaths, etc. Friends have always maintained that war and oaths were inconsistent with Christianity, being forbidden by Christ and his apostles in the New Testament. Consistent members refuse to perform military service or partake in war-like preparations. They refuse oaths in civil courts or elsewhere as forbidden by Christ's language, "Swear not at all." In their early history they suffered much on this account. They decline the use of complimentary titles and language, believing they proceed from pride and tend to foster it. They refuse the complimentary use of the plural pronoun to a single person, although the "thou" and "thee" to judges and magistrates has often resulted in suffering. They use the numerical language of Scripture instead of the names of months and days in honor of heathen deities. Their plainness of dress is a testimony against pride, and any uniformity the result of a refusal to change its style at the dictates of fashion.

Present Condition and Membership.— With some unimportant exceptions the society maintained a practical unity until the year 1827. At that time a separation occurred in Philadelphia Yearly Meeting and later in others. Since then two district bodies have claimed the title "Religious Society of Friends," commonly distinguished by the names "Hicksite" and "Orthodox," although not recognized or officially used by either body. The name "Hicksite" came from Elias Hicks, a talented and popular minister of Long Island, whose ministry was the immediate cause of the schism. The Orthodox party hold that unsound doctrines caused the separations. The followers of Hicks, admitting differences in doctrines, contend that the real cause was not so much these differences, as an arbitrary exercise of authority by the Orthodox party. Quotations from Hicks establish the contention that the divinity of Jesus Christ, the doctrine of atonement, and the inspiration and authority of the Bible were denied or questioned. There were probably some grounds for the charge of an arbitrary spirit on the part of the Orthodox. In the separations, two-thirds of Philadelphia and New York yearly Meetings were of the "Hicksite" party, and in Baltimore four-fifths; in Ohio they were about evenly divided, while in Indiana Hicks had comparatively few sympathizers. No separations occurred in New England or North Carolina meetings, they continuing to be identified with the Orthodox bodies, which were officially recognized by London Yearly Meeting.

There are seven yearly meetings of the "Hicksite" Friends: Philadelphia, Baltimore, New York, Genesee (Canada), Ohio, Indiana and Illinois, numbering about 17,800 members. They are connected by epistolary correspondence. Their principal schools are Swarthmore College, and the George School in Pennsylvania, Friends Central in Philadelphia and similar schools in New York and Baltimore. *The Friend's Intelligencer*, an ably conducted weekly paper, is published in Philadelphia.

Several of the Orthodox yearly meetings have experienced separations. Joseph John Gurney of England, a wealthy and educated minister and voluminous writer, expressed views which many in England and America regarded as subversive of some always held by the society. Prominent among those in America who opposed his views was John Wilbur, a minister in New England. This resulted in a division in that Yearly Meeting in 1845, which was followed by one in Ohio in 1854. These, and later separations in others, resulted in two distinct bodies of Orthodox Friends within the limits of six yearly meetings, including Canada. They have been distinguished by the respective names, "Gurney" and "Wilbur," and the terms "Progressive" and "Conservative." In Ohio the "Conservative" body was the larger, and in each of the others the smaller. London gave its official recognition to the "Progressive" bodies. There are now 13 of these, connected with each other and with London and Dublin Yearly Meetings by correspondence: New England, New York, Canada, Baltimore, North Carolina, Ohio, Wilmington (Ohio), Western, Indiana, Iowa, Kansas, Oregon and California. Total membership in America about 75,000.

The six "Conservative" yearly meetings are: New England, Ohio, Canada, Western (Ind.), Iowa and Kansas. These annually exchange epistles. Their membership is about 4,000.

Philadelphia occupies a unique position, not being connected with either of these groups of related yearly meetings. That its sympathies were with Wilbur against the views of Gurney was shown by the recognition of the "Wilbur" Friends in Ohio. Later, in the interest of peace, Philadelphia ceased correspondence with all yearly meetings, and has never regularly resumed it. The membership is about 4,000. Within most "Progressive" yearly meetings paid pastors, prescribed services, singing, instrumental music and revival methods have been introduced; until, in many localities, the so-called "Friends Churches" more nearly resemble "Methodists" than "Quakers." These yearly meetings have organized "The Five Years Meeting," held periodically as the name indicates, having advisory rather than legislative powers. Most of them have recently adopted a "Uniform Discipline." The principal schools of Orthodox Friends in America are: Haverford College, Pennsylvania; Earlham College, Ind. (Iowa) Guilford College, North Carolina; Pacific College, Oregon; Westtown Boarding School, Pennsylvania; Friends Select School, Philadelphia; Friends Boarding School, Providence, R. I.; Friends Boarding School, Barnesville, Ohio. Their principal periodicals are *The Friend,* Philadelphia (weekly) and *The American Friend,* Philadelphia (weekly), organ of the Progressive Yearly Meetings.

Statistics.— The total membership in 1918 was given as about 142,000, the distribution being as follows: "Orthodox" in America, 97,514; in Great Britain, Ireland and Australia, 22,350. The "Hicksite" membership was about 17,806; that of the "Wilburites" 4,000; that of the "Primitive" branch 171. The Continental membership (Norway, Denmark, Germany, France, Turkey) was given a few years ago as 247.

Bibliography.— Brailsford, M. R., 'Cromwell's Quaker Soldiers' (*Contemporary Review,* New York 1915); Braithwaite, W. C., 'The Beginnings of Quakerism' (London 1912); Clarke, M. E., 'The Friends in France' (*Cornhill Magazine,* London 1916); Cunningham, Y., 'The Quakers from their Origin Till the Present Time' (London 1897); 'Early Quakerism in Ireland' (*Friends' Historical Society Journal,* London 1910); Fox, G., 'The American Journey of George Fox, 1671-73' (*Friends' Historical Society Journal,* London 1912); Holder, C. F., 'The Quakers in Great Britain and America' (New York 1913); Jones, R. M., 'The Quakers in the American Colonies' (London 1911); Penn, W., 'A Brief Account of the Rise and Progress of the People called Quakers' (London 1695) and 'The Select Works of William Penn' (London 1825); Speakman, T. H., 'Divisions in the Society of Friends' (Philadelphia 1893); Woodman, C. M., 'The Present Day Message of Quakerism' (Boston 1915).

Edwin P. Sellew,
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FRIENDS OF GOD, a body of religious reformers of the 14th century. They were mystics and labored for the reformation of society and the Church. The brotherhood included many members of religious orders, especially Dominicans. It appears to have flourished more especially in Basel, Cologne and Strassburg. Consult Jones, 'Studies in Mystical Religion' (New York 1909); Jundt, 'Les amis de Dieu au quatorzième siècle' (Paris 1879); Rieder, 'Der Gottesfreund vom Oberland' (Innsbruck 1905).

FRIENDS OF THE PEOPLE, society founded in 1792 by Sheridan and Grey with the object of bringing about parliamentary reform. Fox and Pitt were opponents of its program. Grey introduced reform bills in 1792, 1793 and in 1797, but the time was not ripe for such changes because the nation was engaged in a long struggle on the Continent. It was not until after the downfall of Napoleon that the nation could turn to home reforms. The movement finally achieved its triumph in the Reform Bill of 1832.

FRIENDS OF THE TEMPLE, a German sect, called also the Temple Society and Hoffmannites, founded by the Rev. Christopher Hoffman at Württemberg about 1850. The Scriptures are accepted in their entirety, all the biblical prophecies are to be fulfilled and the members are bound to labor to accomplish this end. In order to do so the people of God are to be gathered in Palestine. Temples are instituted in different countries in order to facilitate this object. The sect established a colony at Jaffa in 1868, and others subsequently at Haifa, Sarona, Jerusalem and other points in Palestine. Hoffman died in 1885 and the religious side of the movement has since declined; at present the movement is important on its economic side and because of its furtherance of German interests in the East. Outside of Palestine there are communities in Württemberg, Alexandria, Egypt and one of 350 members in the United States. The Eastern communities have a total membership of about 1,500. Consult Hoffmann, 'Occident und Orient' (Stuttgart 1875); id, 'Mein Weg nach Jerusalem' (ib. 1881-85); Kalb, 'Kirchen und Sekten der Gegenwart' (1907).

FRIENDS UNIVERSITY, an institution of higher learning founded at Wichita, Kansas, by the Society of Friends in 1898. The faculty numbers 20; the average annual attendance of students is 300. The tuition fees are $50; the total productive funds $210,000; total annual income $22,600. The library contains over 8,000 volumes. The total number of graduates since organization is 275.

FRIES, frēs, **Elias Magnus,** Swedish botanist: b. Smaland, Sweden, 15 Aug. 1794; d. Upsala, 8 Feb. 1878. He was educated at Lund and in 1828 was appointed demonstrator in botany there. In 1834 he was called to the chair of practical economics at Upsala, with which in 1851 that of botany was conjoined. His botanical investigations deal with the field of systematic botany, but his work is especially valuable in its additions to our knowledge of lichens, mosses, fungi, etc. Fries introduced into Sweden the morphological theory in his 'Systems of the Vegetable World' (1825). His work on 'Mycology' (1820-32) was long the standard work on the classification of fungi, of which he gave a relatively complete catalogue in 'Scandinavian Flora' (1846–49). He wrote a series of useful books on the *Hymenomycetæ,* on lichens, and on the flora of Scandinavia, more particularly of Sweden. Among his monographs is one on the 'Hieracieæ' (1848). In 1851 Fries was appointed director of the botanical museum and garden at Upsala, and in 1853 rector of the university.

FRIES, Jakob Friedrich, German philosopher: b. Barby, Saxony, 23 Aug. 1773; d. Wartburg, Germany, 10 Aug. 1843. He received his education at Leipzig and Jena and in 1801 was appointed lecturer in philosophy at the latter university. He was professor of philosophy and elementary mathematics at Heidelberg 1806–16, after which he held the chair of theoretical philosophy at Jena. He is a link between Kant's system and the so-called historical school. According to his theory philosophy is founded in the last analysis in subjective knowledge and it is propounded thoroughly only by means of psychological analysis. 'The New or Anthropological Critique of Reason' (1807) is his most important book. He wrote also 'Handbook to Psychical Anthropology' (1820); 'System of Metaphysics' (1824), etc.

FRIES, John, American insurgent: b. 1764; d. 1825. He had a varied career, becoming in succession a cooper, soldier and auctioneer. His career of soldier was undertaken in the so-called Whisky Insurrection. When in July 1798, Congress voted a direct tax of $2,000,000 the Federal officers who were sent to Pennsylvania to collect the State quota of $237,000, were resisted by a party of opposition which Fries had rallied from among the Germans of Montgomery, Lehigh, Bucks and Berks counties. At Bethlehem, 7 March 1799, the United States marshal was compelled by this party to release 30 prisoners who had been arrested for refusing to obey the law. The «rebellion» was at length put down by the militia which President Adams ordered out, and among those captured was Fries, who was subsequently twice tried and on each occasion sentenced to death. In April 1800 he was pardoned by President Adams, who at the same time proclaimed an amnesty to all concerned in the «rebellion.» Removing to Philadelphia he engaged in the tinware business in which he became comparatively wealthy. Consult Davis, 'The Fries Rebellion' (Doylestown, Pa., 1899); McMaster, 'History of the People of the United States' (Vol. II, New York 1907); and, for an account of the trials, 'Das erste und zweite Verhör von John Fries' (Allentown 1839).

FRIESE, frē'zė, **Richard,** German painter: b. Gumbinnen, East Prussia, 15 Dec. 1854. He studied at Berlin, and traveled in the East, as well as northward within the Arctic Circle. He is now considered one of the best of German animal painters, and is equally successful in depicting the lion in the desert and the deer in a German forest. In 1886 he was awarded a gold medal by the Berlin Academy, of which body he was elected a member in 1892. His most famous works are 'Lions Surprising a Sleeping Caravan' (1884), in the Dresden Gallery; 'On the Bredszell Moor' (1895), in the Königsberg Museum; 'Elks on Field of Battle' (1890), in the National Gallery, Berlin; 'A Twenty-pronged Stag under Way,' owned by Emperor William II.

FRIESEKE, Frederick Carl, American artist: b. Owosso, Mich., 7 April 1874. He received his art education at the Chicago Art Institute, the Art Students' League, New York, the Julien Academy and the Whistler School, Paris. After 1900 he lived mostly in France; he is of the Impressionist school, and his work shows the influence of Renoir. He has painted many beautiful female figures and has done considerable work in the nude. 'Before the Mirror' hangs in the Luxembourg Gallery; his 'The Toilet' in the Metropolitan Museum, New York; 'The Open Windows' in the Art Institute, Chicago. Mural decorations by him may be seen in the Hotel Shelbourne, Atlantic City, and in the Wanamaker Auditorium, New York. There are also pictures by him in the Gallerie-Modern, Venice; the Modern Gallery, Odessa, Russia; the Telfair Gallery, Savannah, Ga.; the Minneapolis Art Institute; and the Syracuse Museum of Art. He has received several awards, including gold medal, Munich in 1904, silver medal at Saint Louis 1904, prize at the Corcoran Exhibition, Washington 1908, and grand prize for painting at the Panama-Pacific Exposition 1915. He was elected to the National Academy in 1914, and is a member of the National Portrait Society, London; of the Société Nationale des Beaux-Arts, the International Society of Painters and Sculptors and the Society of American Painters, Paris.

FRIESIAN, or HOLSTEIN-FRIESIAN, CATTLE. See DAIRY BREEDS, under CATTLE.

FRIESIAN ISLANDS. See TERSCHELLING; TEXEL.

FRIESLAND, frēz'lănd, or **VRIESLAND,** frēs'länt, a province in the Netherlands, bounded by the provinces of Groningen, Overyssel and Drenthe, and by the North Sea and the Zuyder Zee. It is generally flat, and parts of it are below sea-level, being protected by dykes. Excellent horses, the best in Holland, cattle and sheep are reared, and cattle and other pastoral and agricultural produce are the principal exports. It is sometimes called West Friesland, to distinguish it from East Friesland, now the district of Aurich in Hanover. It is divided into three districts — Leeuwarden, containing the capital of same name, Sneek and Heerenveen. Area, 1,281 square miles. Pop. 366,305. See NETHERLANDS.

FRIETCHIE, Barbara. See BARBARA FRIETCHIE.

FRIEZE, Henry Simmons, American educator: b. Boston, 15 Sept. 1817; d. Ann Arbor, Mich., 7 Dec. 1889. He was graduated from Brown University in 1841, was instructor there from 1841–45, conducted the grammar-school connected with the university 1845–54, and from 1854 until his death was professor of the Latin language and literature in the University of Michigan, of which in 1869–71, 1880–82 and 1887–88 he was the acting president. He was a pioneer in the teaching of Latin on more advanced lines, laying more stress on the interpretation of Latin texts as literature than as illustrations of grammatical rules. He was also an advocate of the elective in place of the compulsory system, and the originator of the system by which graduates of preparatory schools approved by the university are admitted on the strength of their diploma without examination, a system which has been copied by almost all the important universities in this country. In every direction he did much to promote the interests of the university, being chiefly responsible for the establishment of its school of political science and its school and museum of art; also obtaining for it a State appropriation of $75,000 and an important library in political science. He published an edition (1860) of the 'Æneid,' and (1867) of the 'Ars Rhetorica'; and 'Giovanni Dupré' (London 1886). Consult Angell, J. B., 'A Memorial Discourse on the Life and Services of H. S. Frieze' (Ann Arbor 1890); Butterfield, C. W., 'H. S. Frieze' (in *Magazine of Western History*, Vol. V, p. 254, Cleveland 1886); Kelsey, F. W., 'H. S. Frieze' (in *Nation*, Vol. L, p. 8, New York 1890).

FRIEZE, (1) the architectural term for the central part of an entablature between architrave and cornice or any similar position, in a work of structural decoration. It is often enriched with figures of animals, etc., in relief, and in the Doric order (q.v.) of architecture is divided by triglyphs into metopes. One of the best-known examples is the Panathenaic frieze around the cella of the Parthenon, (q.v.) part of which is now in the British Museum. It was used especially in classic and neo-classic architecture. Consult Bone, H. A., 'Frieze and its Origin' (in *Art Journal*, Vol. LIII, p. 149, London 1901). See ARCHITECTURE. (2) The name of a thick woolen stuff or cloth with a nap on one side, in use since the 14th century for heavy outer garments. Frieze is largely made in Ireland, whence considerable quantities are exported.

FRIGATE, the designation in the days of wooden war vessels of a full-rigged ship with two decks, and so distinguished from a ship of the line which had three. In time frigates were designed to ensure speed and ease in working them, while they remained of moderate size. After 1600, the frigate type became more or less fixed although a rigid adherence to a single form was not demanded until about 1750, after which frigates were classified as forty-fours, thirty-eights, thirty-sixes, thirty-twos, twenty-eights and twenty-fours; this classification being made on the basis of the number of guns aboard. In the British navy the tonnage of frigates was from 500 to 1,200, while in the early days of the United States navy, vessels over 1,200 tons were at times classed as frigates. Frigates were usually fast sailers, mounted with 28 to 60 guns, and were employed as scouts and as cruisers, to convoy merchantmen, etc. With the introduction of armor-clad war vessels the term frigate has been superseded by that of cruiser, but a large full-rigged merchantman is still sometimes so called. The name originally was used in the Mediterranean to designate a long, swift vessel propelled by oars and sails. Consult Chatterton, E. K., 'Ships and Ways of Other Days' (Philadelphia 1913); Holmes, G. C. V., 'Ancient and Modern Ships' (2 vols., London 1906).

FRIGATE-BIRD, or **FRIGATE PELICAN.** See MAN-OF-WAR HAWK.

FRILL-LIZARD, a large Australian lizard (q.v.) (*Chlamydosaurus kingi*) of the family Agamidæ, so called in allusion to the erectile collar or ruff about its neck. This broad membrane is supported on each side of the neck by slender rods from the hyoid bone which extend to its margin like the sticks of a fan; and like a fan it may be folded close against the shoulders or spread until it stands up all around the back part of the head; but this erection can be accomplished only by opening the mouth widely, and always accompanies a stretching apart of the jaws. The exterior of the frill is of the general grayish-brown of the animal's body, but its interior or front is scarlet; and when it is suddenly spread in the face of an enemy behind the open hissing mouth, it is calculated to astonish and frighten the attacker in no small degree, as seems to be the purpose of the structure. These lizards are six to eight inches long plus a long, lashlike tail. They spend their time on trees and logs, searching for the beetles which constitute their principal food; and have an extraordinary manner, when in haste, of rising and running upon their hind legs alone. Consult Kent, W. Saville, 'The Naturalist in Australia' (London 1897).

FRIMAIRE, frē'măr' (Fr. sleety), the third month of the French Republican Calendar of 1793. It began on 21 November in years II–III, and V–VII; on 22 November in years IV, VIII–XI, XIII, XIV, and on 23 November in the year XII.

FRINGE-TREE (*Chionanthus virginica*), a beautiful tree of 10 or 20 feet in height, with oval, smooth, entire leaves, white narrow-petaled flowers in drooping racemes, and oval, purple drupes. Its blossoms are not only suggestive of its English name, but of the generic title of *Chionanthus*, «blossoms of the snow.» It is found in the United States from latitude 39° to the Gulf of Mexico, and forms an attractive feature in garden shrubbery. In the Southern States it is known as old-man's-beard.

FRINGES, (1) in optics, the bands of light and drak due to the interference of light waves, produced when a beam of light passes the sharp edge of a screen, or passes through a narrow slit or biprism. (See DIFFRACTION OF LIGHT; OPTICS; INTERFERENCE; LIGHT). (2) In the English Bible, the translation of the Hebrew *gedilim* in Deut. xxii, 12, and of *sisith* in Numbers xv, 38. Consult Benzinger, 'Hebräische Archäologie' (2d ed., Tübingen 1907); Nowack, 'Hebräische Archäologie' (Freiburg 1894); and Robertson-Smith, 'Religion of the Semites' (London 1894).

FRINGILLIDÆ, frĭn-jĭl'ĭ-dē, the finch and sparrow family, an extensive group of oscine birds, regarded as the most highly organized of all birds. The old name *Fringilla*, applied by Linnæus to the whole group, is retained only for the typical genus, represented by the chaffinch (q.v.). All the fringillines are small, compact and active, without eccentricity of form or plumage, and with organs adapted to an omnivorous diet, although seeds form the principal part of the fare. The bill is usually stout and cone-shaped, varying from a greatly swollen size in some of the grosbeaks to the slenderness of that of the goldfinch. The legs are short, and scutellate; the feet strong; and the wings and tail do not vary much from normal, but the wing has a minute outer primary. The plumage is varied, and in many genera the sexes are unlike. These birds mainly frequent fields, roadsides and woodlands; and build their nests (often elaborate structures) in trees, in bushes or on the ground — never in burrows, or tree-holes, or composed of mud. Their eggs are usually five in number, and usually are spotted. The family includes extremely good singers, and furnishes us not only the canary but many other of the most popular cage-birds; also many whose flesh is considered a delicacy. The group is divided into scores of genera and contains hundreds of species, which predominate in the northern latitudes of the Old World, where many are resident throughout the year; but they also abound in all other parts of the world except Australia. Consult Coues, E., 'Key to North American Birds' (5th ed., 2 vols., Boston 1903); Evans, A. H., 'Birds' (London 1899); Ridgway, R., 'Birds of North and Middle America' (Part I, Washington 1901); Sharpe, R. B., 'Catalogue of the Passeriformes or Perching Birds in the Collection of the British Museum' (London 1888). See BUNTING, FINCH, GROSBEAK, LINNET, REDPOLL, SPARROW, and names of various species.

FRISBY, Edgar, American astronomer: b. Great Easton, Leicestershire, England, 22 May 1837. He received his education at the University of Toronto where he was graduated in 1863. For the ensuing four years he taught in Canada, afterward becoming acting professor of mathematics at Northwestern University. Later he became assistant astronomer at the United States Naval Observatory, Washington, and professor of mathematics in the United States navy. He was retired on 22 May 1899, and now holds the relative rank of commander. For the government he observed several eclipses and made a noteworthy computation of the orbit of the comet of 1882. Until his retirement he was in charge of the government's 12-inch equatorial telescope.

FRISCHES HAFF (L.G., Fresh-water Bay), Germany, a lagoon on the north of Prussia, south of the Gulf of Danzig. It is about 57 miles long, with a breadth varying from 2 to 18 miles, and an area of 330 square miles. Its depth varies from 10 to 18 feet. Until 1510 it was entirely cut off from the Gulf of Danzig by the Frische Nehrung; in that year the waters broke over the Frische Nehrung at its northeastern extremity, forming the passage called the Gatt. This passage was originally from 10 to 15 feet in depth, but has been dredged to a depth of 22 feet. Vessels of greater draft than this load and unload at Pillan, which is located at the mouth of the Gatt. Cargoes are thence conveyed by lighters to and from the ports on the Frisches Haff. The Nogat, Frisching, Pregal, the Passage and part of all the waters of the Vistula flow into the Frisches Haff.

FRISCHMANN, David, Hebrew author: b. Lodz 1863. He removed to Warsaw in early life, began to write at 13, and came into public notice by his endeavor to overthrow the archaic traditions of Hebrew literature, which throughout his life he has earnestly sought to pattern after European models. He has translated Bernstein's 'Naturwissenschaftliche Volksbücher'; Byron's 'Cain'; Nietsche's 'Thus Spake Zarathustra' and other works. He has written much both in prose and verse. He works have been published in 17 volumes at Warsaw.

FRISCO, a popular abbreviation of the name San Francisco.

FRISIANS, a people of Teutonic stock, who at the beginning of the Christian era occupied the coast lands stretching from the mouth of the Scheldt to that of the Ems. They were closely related by speech and blood to the Angles and Saxons, and the other Low German tribes, who lived in Schleswig-Holstein and to the east of the Ems. The first notice of this people is found in the 'Annals' of Tacitus. They became tributaries of Rome under Drusus, and lived for some time on friendly terms with their conquerors, but were driven to hostilities by oppression. They submitted again in 47 A.D., and in 58 attempted to extend their territory between the Rhine and Yssel; in 70 they rebelled again with the Batavians in the campaign of Claudius Civilis. From this time on their history is obscure for several centuries. They appear to have been confused with their neighbors, the Saxons and Batavians. It is very probable that great numbers of Frisians joined with the Angles and Saxons in their sea-roving expeditions, and assisted them in their invasions and conquest of England and the Scottish lowlands. About the end of the 7th century, the Frisians in the southwest were subdued by the Franks under Pépin d'Héristal, who compelled them to accept Christianity. A century later the eastern branch of the tribe was conquered and christianized by Charlemagne. Their country was divided into three districts, two of which were annexed on the division of the Carlovingian Empire to the possessions of Louis the German, and the other to Charles the Bald. The latter part was called West Frisia (West Friesland), and the two former East Frisia (East Friesland). The distinctive national features were gradually lost by assimilation with their neighbors, and their modern history is chiefly connected with Holland and Hanover.

Bibliography.— 'Gesta regum Francorum'; Emmius, Ubbo, 'Rerum Frisicarum historia' (Leyden 1616); Winsemius, P., 'Chronique van Vriesland' (Franoker 1822); Klopp, O., 'Geschichte Ostfrieslands' (3 vols., 1854–58); Hooft van Iddekinge, 'Friesland en de Friezen in de Middeleeuwen' (Leyden 1881); Blok, P. J., 'Friesland im Mittelalter' (Leer 1891).

Language and Literature.—A Low German dialect, formerly spoken along the North Sea coast from the Scheldt to the Ems, where dwelt the Frisians, from whom it takes its name. It is now much more restricted in territory, and is confined almost entirely to the peasantry. It is closely akin to Anglo-Saxon, and has many points in common with Dutch, Danish and Icelandic. As now spoken it is divided into numerous dialects, some of which differ widely one from the other. The general dialectic divisions are East, West and North Frisian. The East Frisian is again divided into the Ems and Weser dialects. It has been supplanted by Plattdeutsch, and is now spoken by but a few hundred people in the Saterland of Oldenburg and on the island of Wangeroog. The name East Frisian, however, is popularly given to the dialect of Plattdeutsch which has supplanted the older tongue. The North Frisian is subdivided into about 10 dialects, many of which are but admixtures of Low German, Danish or West Saxon. Of the pure North Frisian there is scarcely any record. West Frisian has extensive literary remains, however, and modern West Frisian is the vehicle of all modern Frisian literature. It is subdivided into six dialects, which do not diverge greatly. The morphology of the language is essentially of the German type and its syntax is of the type of the older German dialects.

Old Frisian literature is very scanty, consisting mainly of collections of laws, a few epic poems and sagas. The Asegabuch (1200) was a series of laws valid for all Friesland. An almost complete collection of those laws is to be found in Richthofen's 'Friesische Rechtsquellen' (1840). Most of the poetry is a mixture of dialects which renders it useless for the study of the language; 'Thet freske Rijm,' a collection made in 1671, is a good example. The most important work in North Frisian is 'Di Gidtshals of di Söl'ring Pid'ersdei' of Hansen, a comedy published at Flensburg in 1809, and which appeared in a second edition together with 'Di leddelk Stjüürman,' a story and some poems at Sonderburg in 1833. In West Frisian has appeared nearly all modern Frisian literature of any consequence. Its period began in 1609 with the comic dialogue entitled 'Een tramensprekinghe van twee boersche Personem, Wouter en Lialle.' West Frisian poetry received considerable impetus from the work of Gijsbert Japiks and Jan Althuysen in the 17th and 18th centuries, respectively. Since then there has been no great name in Frisian poetry, and comedy portrayals of peasant life form alike the best and bulk of modern Frisian literature. The most famous of these comedies are Meindert's 'It libben fen Aagtje Ijsbrants, of dy frieske boerinne' (1779); 'De tankbre boerezoon' (1778); 'De reijs fen Maicke Jakkelis' (1778); and 'Het jonge lienes boosk.' Other names of more recent date are Eeltje (1797–1858), Salverda, Rinse. Van Blom, Van der Wey-Rutgers, van der Veen, W. Dijkstra and Pieter Troelstra.

Bibliography.— Bendsen, 'Die nordfriesiche Sprache nach der Mohringer Mundert' (Leyden 1860); Colmjon, 'Beknopte friesche Spraakkunst vor den tegenwoordigen Tijd' (Joure 1889); Cummins, 'Grammar of the Old Frisian Language' (London 1887); Dijkstra and Hettema, 'Friesch Woordenboek' (4 vols., Leeuwarden 1896–1903); Grimm, 'Deutsche Grammatik'; Helten, 'Zum altfriesichen Vokalismus' (Strassburg 1906); Hewett, 'Frisian Language and Literature'; Hettema, 'Oude friesche Wetten' (Leeuwarden 1845–51); Henser, 'Altfriesisches Lesebuch mit Grammatik und Glossar' (Heidelberg 1903); Jaekel, "Die alt friesische Verse vom hute des abba" (in *Zeitschrift für deutsche Philologie*, Vol. XXXI, Halle 1907); Johansen, 'Die nordfriesische Sprache' (Kiel 1862); Kock, "Vokal-balance im Alt friesichen" (in 'Beetrage zur Geschichte der deutschen Sprache und Litteratur,' Halle, 1904); Richthofen, 'Altfriesisches Wörterbuch' (Göttingen 1840); id., 'Friesische Rechtsquellen' (Berlin 1840); Siebs, "Geschichte der friesischen Sprache" (in 'Grundriss der germanischen Philologie' von Paul, Vol. II, Strassburg 1901–09); id., 'Geschichte der friesischen Litteratur,' Vol. III (ib. 1900); id., 'Sylter Lustspiele' (Griefswald 1898); id., 'Zur Geschichte der Englisch-friesisch Sprache' (Halle 1889); Sipma, 'Phonology and Grammar of Modern West Frisian' (Oxford 1913); Sturenburg, 'Ost-friesisches Wörterbuch' (Aurich 1862); Ten Doornkaat Kooman, 'Wörterbuch der Ostfriesischen Sprache, etymologisch bearbeitet' (3 vols., Norden 1879–84); Van Helten, 'Altosttriesische Grammatik' (Leeuwarden 1890); Walter, 'Der Wörtschatz des Altfriesischen' (Naumburg 1911); Winkler, 'Algemeen nederduitschen en friesch Dialecticon' (The Hague 1874).

FRIT. See Glass.

FRITH, John, English Protestant martyr: b. Westerham, Kent, 1503; d. Smithfield, 4 July 1533. He was educated at Eton and at Cambridge, where he was graduated in 1525, and in the same year on the advice of Wolsey removed to Cardinal (now Christ Church) College, Oxford. Here he assisted Tyndal in his translation of the New Testament. Because of his leanings toward the Reformers he was for a time imprisoned at Oxford but Wolsey procured his release and he went to the Continent, where he was associated with Tyndal at the Protestant University of Marburg. He returned to England in 1532 and warrants were issued for his arrest without delay. He evaded arrest for several months but was at last taken at Milton Shore, Essex, when about to depart to Flanders. After the manner of the time his imprisonment in the Tower was rigorous, mitigated a trifle under the chancellorship of Sir Thomas Audley. Just at a time when Cranmer and Cromwell were disposed to be lenient in his regard, Frith's enemies circulated a manuscript 'Lytle Treatise on the Sacraments,' which he had written for the information of a friend and with no view to publication. He was charged with denying the necessity as articles of faith of the doctrines of purgatory and transsubstantiation. He was found guilty, was turned over to the secular power 23 June 1533, and 11 days later was burned at Smithfield, London. Frith's works include a translation of Patrick Hamilton's 'Places'; 'A Pistle to the Christen Reader,' under the pseudonym of Richard Brightwell; 'Antithesis wherein are compared togeder Christes Actes and our Holye Father the Popes' (1529); 'Disputacyon of Purgatorye' (1531) directed against Rastell, Sir T. More and Fisher of Rochester. During his captivity he wrote several letters, a reply to More and some tracts. Frith is important in ecclesiastical history as having been the first to maintain the doctrine concerning the sacrament of Christ's body and blood, which ultimately was incorporated in the communion office of the Church of England. Later Cranmer, one of Frith's judges, was sent to the stake for the same belief and three years after the latter's death it became the professed faith of the English Church. Frith's works were published by Foxe (London 1573) and again in 1631. Consult Burnet, G., 'History of the Reformation of the

Church of England' (1865); Richmond, L., 'The Fathers of the English Church' (1807); 'Life and Martyrdom of John Frith' (London 1824); Alcock, Deborah, 'Six Heroic Men' (London 1906).

FRITH, William Powell, English painter: b. Studley, near Ripon, 9 Jan. 1819; d. 2 Nov. 1909. Since 1840, when he exhibited 'Malvolio before Olivia' at the Royal Academy, he produced a great number of scenes from Shakespeare, Molière, Dickens, Sterne, Goldsmith, etc., besides his immensely popular pictures, 'Coming of Age' (1849); 'Life at the Sea-Side' (1854); 'The Derby Day' (1858); 'The Railway Station' (1862); 'Before Dinner at Boswell's Lodgings' (1868 — sold in 1875 for £4,567); 'The Private View at the Royal Academy' (1881); 'Marriage of the Prince and Princess of Wales' (1865). Large engravings have been produced from a number of his pictures. In 1887–88 he published his autobiography.

FRITHJOF'S (frĭt'yōf) **SAGA.** This lyrical epic in 24 cantos by Esaias Tegnér was completed in 1825. This is the most famous literary work produced in Sweden, and for many years has been very popular throughout Europe. It is based on the romantic story, 'Frithjof's Saga,' written by an unknown author in Iceland about 1300. We find in the original saga, for the first time in the early Norwegian-Icelandic literature, resignation praised as a virtue of real manhood; also, for the first time, a love story with a happy ending. According to Tegnér's 'Explanatory Letter,' Œhlenschlæger's 'Helge' gave him the idea of Frithjof, but the treatment is different. The Swedish author has modified the original saga and made many additions, drawn from other Icelandic sagas and from the 'Edda.' "My object was to represent a poetical image of the old Northern hero age. The heroine Ingeborg says of Frithjof: How glad, how daring, how inspired with hope

"Against the breast of Norn [Fate] he sets the point
Of his good sword, commanding: 'Thou shalt yield.'"

These lines contain the key to Frithjof's character. All that may be offensive to the modern way of thinking in the conduct of a hero and warrior of old has been left out or smoothed over. The poem presents itself in conformity with the literary views and taste of the author's own age. As works of consummate art may be mentioned such cantos as 'Frithjof's Courtship,' 'Ingeborg's Lamentation,' 'The Viking Code,' 'The King's Election.' Each canto has its own peculiar form of stanza and metre. 'Frithjof's Saga' has been translated into English more than a score of times, also into almost all the languages of the Continent. It has been set to music by B. Crusell and others. In Germany it was for a long time customary to give boys and girls a beautifully bound copy of this work as a present at the time of their confirmation. In 1913 the Kaiser presented to the Norwegian people a colossal monument of Frithjof, which has been erected at Sogn, where he was supposed to have lived about 800 A.D.

Gisle Bothne.

FRITILLARY, *in botany,* a plant of the genus *Fritillaria,* of the lily family, found in the North Temperate and Arctic zones. The plants are herbaceous, the leaves simple, alternate, though sometimes appearing opposite or verticilate; the flowers terminal and pendent; the perianth campanulate, of six petals; the stamens six; the style trifid. About a dozen species are known, several of which are cultivated in gardens, being hardy and highly ornamental plants. The *F. imperialis,* or crown imperial, supposed to be a native of Persia, has large orange or yellow flowers nodding beneath a terminal tuft of leaves. The bulb is poisonous, as is that of *F. meleagris,* though in a less degree.

In entomology, a butterfly of the nymphaline genus Argynnis, containing some 50 species widely distributed in North America and others in the Old World. They are of medium or large size, usually red-brown with black markings in wavy transverse lines and rounded spots near the outer margin of the wings. Several species are among our most common and best-known butterflies. The name is also given to species of the related genera Dione, Euptoeta and Brenthis, the last of small size and darker hue.

FRITSCH, Gustav Theodor, German scientist: b. Kottbus, Brandenburg, 1838. He was educated at Berlin, Breslau and Heidelberg, went on a scientific expedition to South Africa in 1863–66 and was appointed an assistant in the Berlin Anatomical Institute in 1867. In the following year he journeyed with an expedition to Aden to observe a total eclipse of the sun and in 1874 he accompanied another expedition to Ispahan, Persia, to observe the transit of Venus. In 1874 also he was made professor of comparative anatomy at the University of Berlin, and later was appointed to the chair of physiology also. The Berlin Royal Academy of Sciences sent him to the Mediterranean countries in 1882 to study electric fishes. He has published 'Drei Jahre in Südafrika' (1868); 'Die Eingeborenen Südafrikas' (1873); 'Die elektrischen Fische' (2 vols., 1887–90); 'Die Gestalt des Menschen' (1899; 1905); Aegyptische Volkstypen' (1904); 'Das Haupthaar und seine Bildungsstätte bei den Rassen des Menschen' (1912).

FRITZ, Der alte, (Ger., Old Fritz), nickname given to Frederick the Great by his soldiers.

FRITZ, John, American iron and steel expert: b. Londonderry, Pa., 21 Aug. 1822; d. 13 Feb. 1913. He was at first a machinist in shops at Parkersburg and Norristown, and subsequently was a constructor of rolling-mills, acquiring in the latter capacity an authoritative knowledge of iron and steel manufacture. He equipped the Bethlehem iron and steel works, and was for many years manager of that well-known establishment. Many methods of manufacture now in general use were employed by Fritz among the first in this country, including the Bessemer process. Several manufacturers and scientists established in 1902 the award of the Fritz medal to be given for discovery in the fields of science. In 1910 the Franklin Institute awarded him the Elliott Cresson medal. He was president of the American Institute of Mining Engineers in 1894 and of the Society of Mechanical Engineers in 1896.

FRITZ, Samuel, German missionary: b. Bohemia 1656; d. Quito, South America, 1728. He joined the Jesuit Order in 1673, and in the following year was sent to Cartagena. He completed his studies at Quito and went as missionary to the upper Amazon region in 1686. His health failed and he removed to Pará at the mouth of the river, where he suffered imprisonment as a spy at the hands of the Portuguese governor of Pará. He was released in 1691, but returned to his former missionary field in 1693. Here he founded the Omaguas missions during his 42 years of labor among the aborigines, being since known to his brother Jesuits as "the Apostle of the Omaguas." He prepared a map of the upper Amazon region and published it in 1707 at Quito. It reappeared in the 'Lettres édifiantes' (Vol. XII, 1717). It was long the recognized authority on the upper river system.

FRITZ, Unser (Ger., Our Fritz), popular German name bestowed on Frederick William (1831–1888), Crown Prince of Prussia, afterward Emperior Frederick III, and father of the reigning Emperor William II.

FRITZNER, Johan, Norwegian clergyman and lexicographer: b. Askö 1812; d. 1893. He received his education at Christiania and for many years labored in several pastorates. He later devoted himself to literary work. His greatest work is his excellent dictionary of Old Norse, 'Ordbog over det gamle norske Sprog' (1861–67; 2d ed., 1883–96).

FRITZSCHE, Franz Volkmar, German classical scholar: b. Steinbach, Saxony, 1806; d. Rostock 1887. He was educated at the University of Leipzig, where he studied under Beck and Hermann. From 1828 until his death he held the chair of eloquence and poetry at Rostock. He wrote much on the Greek dramatists, especially Aristophanes. His best known works are 'Quæstiones Lucianeæ' (1826); an edition of Lucian's 'Dialogi Deorum' (1829); editions with commentary, of Aristophanes' 'Thesmophoriazusæ' (1838) and 'Frogs' (1845); a critical edition of Lucian's complete works (1860–74) and 'Recension des Buches Aeschylos Eumeniden von K. O. Müller' (1834), a defense of his former master, Hermann.

FRIULI, frē'oo-lē, Italy, formerly independent duchy, consisting, in its widest extent, of the modern Italian province of Udine, the Austrian County of Görz and Gradiska, and the circle of Idria. It derived its name from that of its chief town, Forum Julii, which was said to have been founded by Julius Cæsar. It was one of the most important duchies of the Longobard Kingdom, and after the overthrow of that monarchy by Charlemagne, and even up to the 15th century, when it was conquered by Venice and its territories dismembered, it retained a considerable degree of independence. The inhabitants, called Furlani, are Italian for the most part, but speak a peculiar dialect, into which a strong Celtic element has been introduced. The area of the district is about 3,300 square miles; its population about 700,000. Consult Manzano, 'Annali del Friuli' (Udine 1858–79); and Fracassetti, 'La Statistica etnografica del Friuli' (ib. 1903).

FRÖBEL, Julius, German editor and politician, nephew of Friedrich Froebel (q.v.): b. 1805; d. 1893. He pursued his studies at Munich, Weimar and Berlin, and in 1833 was appointed professor of mineralogy in the industrial schools of Zürich, Switzerland, and was also editor of *Der schweizerische Republikaner.* He gave up his professorship after 11 years and engaged in publishing scientific works and political tracts at Zürich. He removed to Dresden in 1846, and in 1848 was one of the Democratic leaders and a member of the Frankfort Main National Assembly. During this troubled year he visited Vienna in the company of Robert Blum. He was arrested and condemned to death, but because of his great talents he received a pardon from Windischgrätz. He came to the United States in 1849 and edited a German journal in New York until 1850, when he went to Nicaragua, and was later engaged in commercial expeditions in Mexico. In 1855 he was editor of a San Francisco paper and returned to Germany in 1857. In 1862–73 he was editor of newspapers in Munich and Vienna. In the latter year he was appointed German Consul at Smyrna, was transferred to Algiers in 1876 and retired in 1890. He published 'Aus Amerika' (1857), translated (1859) by himself and issued under the title 'Seven Years' Travel in Central America, Northern Mexico and the Far West'; 'Die Wirtschaft des Menschengeachlects' (1870–76); 'Ein Lebenslauf' (1890–91) an autobiography.

FROBEN, or **FROBENIUS, Joannes,** German scholar and printer: b. Hammelburg about 1460; d. 1527. He received his education at the University of Basel. In 1491 he set up a printing press at Basel, which became noted for its excellence. He published editions of Saint Jerome, Saint Cyprian, Tertullian, Hilary of Poitiers and Saint Ambrose. He also published the works of Erasmus, of whom he was an intimate friend. His Greek Testament, edited by Erasmus, was used by Luther for his translation. Froben projected an edition of the Greek Fathers, which was issued after his death by his son Jerome and his son-in-law, Nikolaus Episcopius. Many texts of Froben's were illuminated by Holbein.

FROBISHER, Sir Martin, English navigator: b. Altofts, Yorkshire, about 1530 or 1540; d. Plymouth, 22 Nov. 1594. He was sent to school in London and in 1544 was placed on board a ship sailing to Guinea. He was later in the public service at sea off the coast of Ireland. About 1560 he formed a resolution to undertake a voyage in search of a northwest passage to India, and by his efforts he gave the enterprise a national character. Finally he was put in charge of an expedition, consisting of two barks of 20 and 25 tons, and a pinnace of 10 tons, and an aggregate crew of 35. He set sail on 7 June 1576 by way of the Shetland Islands. Stormy weather resulted in the loss of the pinnace, and soon after one of the vessels, the *Michael,* deserted. Frobisher continued the voyage alone in the *Gabriel* and on 28 July sighted the coast of Labrador in latitude 62° 2' N. Some days afterward he reached the mouth of Frobisher Bay, which he deemed to be a strait. He explored the coast and Butcher's Island until 18 August, and then he returned homewards, reaching London by 9 October. He brought back with him some "black earth" and a rumor soon got abroad that this was really a lump of gold ore. The story aroused great enthusiasm and in the following year a much more important expedition was fitted out, with Frobisher in command. He sailed in May 1577, with three ships and 120 men and reached Hall's Island at the mouth of Frobisher Bay on 17 July. Several weeks were spent in prospecting for gold, but little was done in the way of discovery beyond going over the ground visited on the occasion of the first voyage. A third expedition of 15 vessels was sent out in 1578 and this time Frobisher sailed up a new strait, afterward explored by Henry Hudson (Hudson Strait). In 1580 he became a captain of one of the queen's ships and in 1585 was vice-admiral under Drake in his expedition to the West Indies. He was knighted for his distinguished services in the dispersal of the Spanish Armada in 1588. He continued to cruise in the Channel until 1590, when he was sent in command of a small fleet to Spain. In 1592 Sir Walter Raleigh sent him with a squadron against the Spanish coast, from which he returned with a rich prize. In 1594 he was engaged in the siege and relief of Brest, when he received the wound from which he died later at Plymouth. He was one of the ablest seamen of his time and ranks among the greatest of England's naval heroes. Consult Corbett, Julian, 'Drake and the Tudor Navy' (London 1898); Jones, F., 'Life of Frobisher' (ib. 1878); Hakluyt's 'Voyages,' and the Hakluyt Societies 'Three Voyages of Frobisher' (1867).

FROBISHER BAY, an Arctic inlet, located approximately between 62° and 64° N. and between 65° and 69° W., and opening westward near the mouth of Davis Strait, between Cumberland Sound and Hudson Strait, at the southern end of Baffin Land in the Northwest Territory of Canada. It is about 240 miles long by above 20 wide, with rugged mountainous shores. It was discovered by Sir Martin Frobisher (q.v.), the English navigator, in 1576 and named after him. It was till Hall's voyage called Frobisher Strait, being erroneously regarded as a passage into Hudson Bay. Consult Collinson, R., ed., 'The Three Voyages of Frobisher' (in *Hakluyt Society Publications,* Vol. XXXV, London 1867); Hall, C. F., 'Arctic Researches, etc., 1860–62' (New York 1865); Porter, R. W., 'Frobisher Bay Revisited' (in *American Geographical Society of New York, Journal,* Vol. XXX, p. 97, New York 1898).

FROEBEL, frö'běl, **Friedrich Wilhelm August,** German educationist: b. Oberweissbach, Thuringia, 21 April 1782; d. Marienthal, 21 June 1852. It was Froebel who said, «The clearer the thread that runs through our lives backward to our childhood, the clearer will be our onward glance to the goal»; and in the fragment of autobiography he has left us, he illustrates forcibly the truth of his own saying. The motherless baby who plays alone in the village pastor's quiet house; the dreamy child who wanders solitary in the high-walled garden; the thoughtful lad, neglected, misunderstood, who forgets the harsh realities of life in pondering the mysteries of the flowers, the contradictions of existence, and the dogmas of orthodox theology; who decides in early boyhood that the pleasures of the senses are without enduring influence and therefore on no account to be eagerly pursued;— these presentments of himself, which he summons up for us from the past, show the vividness of his early recollections and indicate the course which the stream of his life is to run.

The coldness and injustice of the new mother who assumed control of the household when he was four years old, his isolation from other children, the merely casual notice he received from the busy father absorbed in his parish work, all tended to turn inward the tide of his mental and spiritual life. He studied himself, not only because it was the bent of his nature, but because he lacked outside objects of interest; and to this early habit of introspection we owe many of the valuable features of his educational philosophy. Whoever has learned thoroughly to understand one child, has conquered a spot of firm ground on which to rest while he studies the world of children; and because the great teacher realized this truth, because he longed to give to others the means of development denied him, he turns for us the heart-leaves of his boyhood.

It would appear that Froebel's characteristics were strongly marked and unusual from the beginning. Called by every one «a moon-struck child» in Oberweissbach, the village of his birth, he was just as unanimously considered «an old fool,» when, crowned with the experience of 70 years, he played with the village children on the green hills of Thuringia. The intensity of his inward life, the white heat of his convictions, his absolute blindness to any selfish idea or aim, his enthusiasm, the exaltation of his spiritual nature, all furnish so many cogent reasons why the people of any day or of any community should have failed to understand him, and scorned what they could not comprehend. It is the old story of the seers and the prophets repeated as many times as they appear; for «these colossal souls,» as Emerson said, «require a long focal distance to be seen.»

At 10 years old the sensitive boy was fortunately removed from the uncongenial atmosphere of the parental household; and in his uncle's home at Ilm he spent five free and happy years, being apprenticed at the end of this time to a forester in his native Thuringian woods. Then followed a year's course in the University of Jena, and four years spent in the study of farming, in clerical work of various kinds, and in land-surveying. All these employments, however, Froebel himself felt to be merely provisional; for like the hazel wand in the diviner's hand, his instinct was blindly seeking through these many restless years the wellspring of his life.

In Frankfort, where he had gone intending to study architecture, Destiny touched him on the shoulder, and he turned and knew her. Through a curious combination of circumstances he gained employment in Herr Gruner's Model School, and it was found at once that he was what the Germans love to call «a teacher by the grace of God.» The first time he met his class of boys he tells us that he felt inexpressibly happy; the hazel wand had found the waters and was fixed at last. From this time on, all the events of his life were connected with his experience as a teacher. Impelled as soon as he had begun his work by a desire for more effective methods, he visited Yverdon, then the centre of educational thought, and studied with Pestalozzi. He went again in 1808, accompanied by three pupils, and spent two years there, alternately studying and teaching.

There was a year of lectures at Göttingen after this, and one at the University of Berlin, accompanied by unceasing study and research both in literary and scientific lines; but in the fateful year 1813 this quiet student life was broken in upon, for impelled by strong moral conviction, Froebel joined Baron von Lützow's famous volunteer corps, formed to harass the French by constant skirmishes and to encourage the smaller German States to rise against Napoleon.

No thirst for glory prompted this action, but a lofty conception of the office of the educator. How could any young man capable of bearing arms, Froebel says, become a teacher of children whose Fatherland he had refused to defend? how could he in after years incite his pupils to do something noble, something calling for sacrifice and unselfishness, without exposing himself to their derision and contempt? The reasoning was perfect and he made practice follow upon the heels of theory as closely as he had always done since he became master of his fate.

After the Peace of Paris he settled down for a time to a quiet life in the mineralogical museum at the University of Berlin, his duties being the care, arrangement and investigation of crystals. Surrounded thus by the exquisite formations whose development according to law is so perfect, whose obedience to the promptings of an inward ideal so complete, he could not but learn from their unconscious ethics to look into the depths of his own nature, and there recognize more clearly the purpose it was intended to work out.

In 1816 he quietly gave up his position, and taking as pupils five of his nephews, three of whom were fatherless, he entered upon his life work, the first step in which was the carrying out of his plan for a «Universal German Educational Institute.» He was without money, of course, as he had always been and always would be,— his hands were made for giving not for getting; he slept in a barn on a wisp of straw while arranging for his first school at Griesheim; but outward things were so little real to him in comparison with the life of the spirit, that bodily privations seemed scarcely worth considering. The school at Keilhau, to which he soon removed, the institutions later established in Wartensee and Willisau, the orphanage in Burgdorf, all were most successful educationally, but, it is hardly necessary to say, were never a source of profit to their head and founder.

Through the 20 succeeding years, busy as he was in teaching, in lecturing, in writing, he was constantly shadowed by dissatisfaction with the foundation upon which he was building. A nebulous idea for the betterment of things was floating before him; but it was not until 1836 that it appeared to his eyes as a «definite truth.» This definite truth, the discovery of his old age, was of course the kindergarten; and from this time until the end, all other work was laid aside, and his entire strength given to the consummate flower of his educational thought.

The first kindergarten was opened in 1837 at Blankenburg (where a memorial school is now conducted), and in 1850 the institution at Marienthal for the training of kindergartners was founded, Froebel remaining at its head until his death two years after.

With the exception of that remarkable book 'The Education of Man' (1826), his most important literary work was done after 1836; 'Pedagogics of the Kindergarten,' the first great European contribution to the subject of child-study, appearing from 1837 to 1840 in the form of separate essays, and the 'Mutter-und-Kose Lieder' (Mother-Play) in 1843. Many of his educational aphorisms and occasional speeches were preserved by his great disciple the Baroness von Marenholtz-Bülow in her 'Reminiscences of Froebel'; and though two most interesting volumes of his correspondence have been published, there remain a number of letters, as well as essays and educational sketches, not yet rendered into English.

Froebel's literary style is often stiff and involved, its phrases somewhat labored, and its substance exceedingly difficult to translate with spirit and fidelity; yet after all, his mannerisms are of a kind to which one easily becomes accustomed, and the kernel of his thought when reached is found well worth the trouble of removing a layer of husk. He had always an infinitude of things to say, and they were all things of purpose and of meaning; but in writing, as well as in formal speaking, the language to clothe the thought came to him slowly and with difficulty. Yet it appears that in friendly private intercourse he spoke fluently, and one of his students reports that in his classes he was often «overpowering and sublime, the stream of his words pouring forth like fiery rain.»

Froebel's educational creed cannot here be cited at length, but some of its fundamental articles are:

The education of the child should begin with its birth, and should be threefold, addressing the mental, spiritual and physical natures.

It should be continued as it has begun, by appealing to the heart and the emotions as the starting-point of the human soul.

There should be sequence, orderly progression, and one continuous purpose throughout the entire scheme of education, from kindergarten to university.

Education should be conducted according to nature, and should be a free, spontaneous growth,— a development from within, never a prescription from without.

The training of the child should be conducted by means of the activities, needs, desires and delights, which are the common heritage of childhood.

The child should be led from the beginning to feel that one life thrills through every manifestation of the universe, and that he is a part of all that is.

The object of education is the development of the human being in the totality of his powers as a child of nature, a child of man, and a child of God.

These principles of Froebel's, many of them the products of his own mind, others the pure gold of educational currency upon which he has but stamped his own image, are so true and so far-reaching that they have already begun to modify all education and are destined to work greater magic in the future. The great teacher's place in history may be determined, by-and-by, more by the wonderful uplift and impetus he gave to the whole educational world, than by the particular system of child-culture in connection with which he is best known to-day.

Judged by ordinary worldly standards, his life was an unsuccessful one, full of trials and privations, and empty of reward. His death-blow was doubtless struck by the prohibition of kindergartens in Prussia in 1851, an edict which remained nine years in force. His strength had been too sorely tried to resist this final crushing misfortune, and he passed away the following year. His body was borne to the grave through a heavy storm of wind and rain that seemed to symbolize the vicissitudes of his earthly days, while as a forecast of the future the sun shone out at the last moment, and the train of mourners looked back to see the low mound irradiated with glory.

In Thuringia, where the great child-lover was born, the kindergartens, his best memorials, cluster thickly now; and on the face of the cliffs that overhang the bridle-path across the Glockner Mountain may be seen in great letters the single word *Froebel,* hewn deep into the solid rock. Consult von Marenholtz-Bülow, 'Reminiscences of Friedrich Froebel' (translated by Mrs. Horace Mann, Boston 1887); Barnard, 'Papers on Froebel's Kindergarten' (1881); Fletcher and Welton, 'Froebel's Chief Writings on Education Rendered into English' (New York 1912); Hauschmann, 'Froebel's Kindergarten System' (1874); Bowen, 'Froebel' (1897); Quick, 'Educational Reformers' (New York 1896).

NORA ARCHIBALD SMITH.

FROG, Nicholas, or **Nic,** national nickname of the Hollanders, first appearing in 'Law is a Bottomless Pit,' by Arbuthnot (1712).

FROG. This familiar animal is the type of the anurous *Amphibia* (order *Anura*). The family *Ranidæ,* to which it belongs, is characterized by having the skin smooth, the hind legs long, and the feet usually completely webbed; teeth are present in the upper jaw and palate, seldom in the lower jaw. The tympanic membrane is situated behind the eyes, and is not concealed. The nostrils are placed at the extremity of the rounded muzzle just above its margin, and open directly into the mouth. When the mouth is filled with air the nostrils are closed, and the animal swallows the bolus of air into the sacculate lungs, there being, in the absence of ribs, no provision for such respiratory movements as take place in the chest of mammals. Frogs are thus air breathers, but they are capable of remaining for a considerable time under water. They swim with great vigor, and on land progress by a series of violent leaps, the long hind limbs being powerful levers. Their food is chiefly insects, which they capture by means of the tongue: this organ is covered with a viscid secretion and is attached in front, its free border being behind; it is rapidly projected from the mouth, the insect adheres to it, and is at once swallowed. The frog does not drink, but its soft skin absorbs fluids rapidly, and thus has a double function both of nutrition and as an aid to respiration. As the frog grows the old outer skin cracks from time to time, and is pulled off and swallowed. The animal retires in winter to the bottom of ponds, from which clusters of frogs may be drawn buried in mud. This hibernation, which is associated with low vital energy, ends in February; in March the spawn is deposited in gelatinous masses of many hundreds of eggs, the males riding for a long period at that season on the backs of the females, and fertilizing the eggs as fast as they are extruded. The eggs soon manifest change, and after a time the young escapes as a "tadpole," a larval animal with short body, circular suctorial mouth, and long tail, compressed from side to side. Gills project on either side of the head from a cleft which answers in position to the gill opening of fishes. The hind limbs first appear as buds, later the fore limbs project, the gills disappear, the lungs becoming more fully developed; the tail gradually shrinks and disappears, and the animal, which was at first fish-like, then closely resembled a newt (or urodele amphibian), finally assumes the adult or anurous form. This is a true process of metamorphosis as complete as that of the butterfly; since there is a change not merely of form and proportion, but also of internal organs. The frog is highest among *Amphibia,* and the successive stages of its development resemble each the adult form of a lower group in its line of ancestry.

Frogs, themselves useful in clearing gardens of slugs and insects, are in turn the prey of birds, especially herons and aquatic birds, of serpents, and fish, the latter destroying large quantities of the spawn. Though exposed to droughts, they can bury themselves in the moist soil and thus live after the ponds are dried up. Though thus tenacious of life, the stories of frogs being found in stone and in trees are for the most part founded on imperfectly noted facts, though it is possible that a frog may now and then get closed into a cavity for which, after entering, it had grown too large; but an aperture must always be present by which water can get access to them. Their fossil history goes back to the early Tertiary days, and probably will be found to extend farther, as Eocene examples differ little from modern forms.

It is by no means easy to define the word "frog" in classification, as distinguished from "toad" (q.v.), and the safest method here will be to deal only with the aquatic family *Ranidæ,* already defined, except as the most highly developed of amphibians. It contains about 280 species and is represented in every part of the world not too cold except southern South America and Australia, where all the so-called frogs belong to a related family, the *Cystignathidæ,* whose members, especially of the subfamily *Cystignathinæ,* may be said to represent the *Ranidæ* in Notogæa. "Some of them," says Gadow, "can be distinguished from the true, typical frogs solely by the arciferous type of the shoulder-girdle and sternum."

The type-genus *Rana* contains more than half the known species, and is scattered all over the northern hemisphere, but is absent from the southern. It is to this genus that the common frogs of Europe and the United States belong — the bull-frog, spring-frog, European grass-frog, etc. The American bull-frog (*R. catesbiana*) is the largest of the whole tribe, occasionally reaching a length of eight inches; and its muffled grunting cry may be heard a mile or more over the water. It is greenish bright upon the head and mottled elsewhere, while the legs are distinctly blotched. This species abounds in all sluggish waters from Kansas eastward, laying its eggs in long strings, and its tadpoles require two years to reach maturity. It is bold and voracious, catching fish, salamanders, other frogs and even ducklings. Its size and the chicken-like daintiness of the flesh in its hind legs, or «saddle,» make it the favorite frog for market, and great quantities are eaten in all parts of the country. In the springs, swamps and ditches lives the green frog (*R. clamata*), not half as big, but very similar in color except that it is yellowish or white below. Another green aquatic frog, still smaller, is the leopard frog (*R. virescens*), whose bright coat is marked with irregular blotches of black edged with whitish, in two rows along the back, and the legs are barred. This species is numerous everywhere as far west as the Sierra Nevada. Another checkered frog, confined to the Eastern States, is the pickerel frog (*R. palustris*), which is light-brown with two rows of large oblong square blotches of dark brown on the back, and one or two on the sides. The head is short, and a dark line extends from the nostril to the eye, while the upper jaw is white, spotted with black spots. Another well-known little kind is the wood-frog (*R. sylvatica*), which goes to the water to breed in early spring, but during most of the year lives in the dry woods. It is a variable reddish brown, with the side of the head marked with a dark-brown band. Several other less conspicuous species of frog inhabit North America, including a few representatives of another family (*Engystomidæ*), besides the tree-frogs, elsewhere described.

For frogs generally consult Gadow's 'Amphibia and Reptiles' (1901); for those of the United States the writings of Holbrook, C. C. Abbott, O. P. Hap, A. W. Butler, and especially 'North American Batrachia,' by E. D. Cope; Dickerson, 'The Frog Book' (New York 1906); Mivart, 'The Common Frog' (London 1874); Marshall, 'The Frog' (11th ed., New York 1912). See also AMPHIBIA; METACHROSIS.

FROG. See RAILWAY CONSTRUCTION, *Frogs and Switches.*

FROG, Flying. See FLYING FROG.

FROG-SHELL, a small mollusk of the *Triton* family (genus *Ranella*), so called because of its shape and mottled colors.

FROGBIT, *in botany,* the popular name for a small floating water plant belonging to the order *Hydrocharideæ*. See HYDROCHARIDEÆ; VALLISNERIA.

FROGFISH, any of several sea-fishes of low organization, toad-like forms and carnivorous habits, constituting the family *Antennariidæ,* and related to the goosefish (q.v.), itself sometimes called «fishing frog.»

FROGHOPPERS, or **FROTH-FLIES,** minute plant-feeding homopterous bugs of the family *Cercopidæ,* which dwell upon plants and may, when very numerous, seriously damage grass crops. The eggs are laid on the stems of plants in the autumn, and survive in the winter. When the embryos hatch (and these resemble the parents, but are wingless) they exude a viscid liquid which is whipped into froth, called in England «cuckoo-spit,» by the thrashing of the «tail,» an anal appendage, probably respiratory in function. The «spittle» is supposed to be a protective disguise, nevertheless the immature insects are preyed upon by wasps, etc. These bugs are called «froghoppers» in double allusion to the froth about their eggs and to their great leaping powers.

FROGMORE, a mansion within the royal demesne of Windsor, Berkshire, England. It was occupied by Charlotte, queen of George III, and later by the mother of Queen Victoria, who died here in 1861. In the grounds are the mausoleum of the Duchess of Kent and the royal mausoleum, a cruciform building with a central octagonal lantern, where lie the remains of the Prince Consort and Queen Victoria.

FROGMOUTH, one of a group of birds, the subfamily *Podarginæ* of the family Caprimulgidæ. They are indigenous to parts of India and to Australia. They have a very wide mouth, a soft plumage and are nocturnal. They have two large powder-down patches on each side of the rump, and have no oil gland.

FROGS, The (Aristophanes' 'Frogs'), is the wittiest comedy in the world and the best index of the intelligence of the audience that could appreciate it. It was produced in 405 B.C. in the brief interval of respite and hope between the victory of Arginusae and the fatal defeat of Ægospotami. The allusions to political conditions and the war are few. The main theme, the descent into hell, had a long history before Aristophanes, running back to the 11th book of the Odyssey; and from Aristophanes to Dante, and from Dante to 'The Houseboat on the Styx,' it has served as the vehicle of contemporary satire. It supplies Aristophanes with abundant motives of comic relief and farce. And the whole is enlivened by the grotesque costumes and the *brek-ke-ke-ke coax* refrain of the chorus of frogs, whose original habitat was the precinct of Dionysus in the marshes. But informing and transcending all this is the serious comedy of ideas — the criticism of the style, temper, thought and ethics of the new poetry. Sophocles and Euripides (as who should say Tennyson and Browning) are dead and there are none to fill their shoes, but very minor bards.

> "And idly tuneful, the loquacious throng
> Flutter and twitter, prodigal of time,
> And little masters make a toy of song,
> Till grave men weary of the sound of rhyme."

These words of William Watson are almost an echo of the complaints of Dionysus, god of drama, poetry and music. Since there are no good poets left on earth, he is resolved to fetch one from Hades. In this quixotic rôle he appears with a Sancho Panza, the slave Xanthias, who plays up to him in the funny business. He takes counsel of Heracles, who had made the journey and who vainly tries to daunt him. He crosses Charon's ferry to the chant of the frogs and is rejoined by Xanthias, who had to walk around the lake because Charon drew the color line on his boat. In the darkness they at first cannot see the malefactors and cutthroats there — but taking a good look at the audience, they discern them. After various comic alarms they fall in with a second chorus, composed of the blest initiates, to whose lovely songs they listen and from whom they inquire «where — in hell — they are." Knocking at Pluto's door, Dionysus, who wears the garb of Heracles, is received with an appalling outburst of Æschylean vituperation from the servant Æacus, who remembers Heracles' former thefts. Dionysus faints, and changes rôles with Xanthias, but insists on resuming his divinity when a message from Persephone invites them to a feast, and cajoles Xanthias into changing yet again upon the eruption of two furious housewives, who recall the misdeeds of Heracles. Æacus returns prepared to execute judgment on the supposed Heracles. But Xanthias, in that rôle, denies his guilt, and in accordance with Attic law, offers in evidence the testimony of his slave (Dionysus) to be taken under torture. Dionysus warns all and sundry that he is an immortal god. Xanthias proposes to test that by seeing which can stand the hardest buffets. The resulting farce is redeemed by the witty device of converting Dionysus' ejaculations of pain into unfinished familiar quotations. "O, mighty Cæsar," he yells — but instantly adds completing the verse, "dost thou lie so low?" A reference to the masters, Pluto and Persephone, clears up the misunderstanding, and after a choric song the two slaves are left outside talking servants' hall gossip. They hear a tremendous uproar within, and Aeacus explains to Xanthias that it is the contest between Aeschylus and Euripides for the tragic throne. Dionysus has been appointed judge, and the contest is transferred to the open stage, where it is accompanied by the comments of the chorus and the ribald interpolations of Dionysus. Beginning with a regular slanging match, the two rival poets analyze one another's dramatic construction and style, parody the blank verse and the lyrics, balance in the scales the weightiness of their meters and criticism of life, and censure the tendencies of their moral and political teaching. No literal version can convey any adequate idea of the wit and subtlety of this penetrating literary criticism. But 'The Rehearsal' and Sheridan's 'Critic' will give the English reader some notion of the kind of effects achieved. Dionysus adjudges the prize to Æschylus, and takes him back to the upper world. The protests of Euripides are met by a parody of his notorious line.

The tongue has sworn — the mind remains unsworn.
The tongue has sworn — but Æschylus's my man.

The justice of Aristophanes' travesty of Euripides "new poetry for a new age" is still under controversy. Recent criticism from Browning's 'Aristophanes' Apology' to the introduction of Professor Murray's translation leans to the side of Euripides. The best brief temperate summary of the older and saner view is to be found in Jebb's 'Lectures on Classical Greek Poetry' (p. 203 ff, 1892).

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FRÖHLICH, frę̄'lih, **Abraham Emanuel**, Swiss poet: b. Brugg 1796; d. Aaran 1865. After 1835 until his death he held the pastorate of Aarau. He wrote many poems and fables which have become very popular, and have attained a high rank among their kind. His best known works are 'Fabeln' (1825); 'Das Evangelium Sankt Johannis in Liedern' (1830); 'Elegien an Wieg' und Sarg' (1835); 'Ulrich Zwingli' (1840); 'Ulrich von Hutten' (1845); and 'Johann Calvin' (1864).

FROHMAN, Charles, American theatrical manager: b. Sandusky, Ohio, 1858; d. at sea, 7 May 1915. Having managed several road companies, he took charge of the Empire Theatre, New York, in 1893, and in 1895–96 organized the syndicate which exercises so large a monopoly in American theatrical affairs. Maude Adams, Julia Marlowe, John Drew and other prominent performers were managed by him and he starred them in various rôles. He managed E. H. Sothern and Julia Marlowe in Shakespearean productions in the season of 1905–06. He opened playhouses in London and was one of the first managers to produce American successes on the London stage and English successes on the American stage. He lost his life on the *Lusitania*, when it was torpedoed by a German submarine.

FROHMAN, Daniel, American theatrical manager: b. Sandusky, Ohio, 1853. He became office boy in the New York *Tribune* office in 1866 and remained five years in the newspaper business. Subsequently he was manager of traveling theatrical companies and later manager of the Madison Square Theatre (1879–85). New York, the Fifth Avenue Theatre and the old Lyceum Theatre, New York. He was also manager of Daly's Theatre, New York, with the Daniel Frohman Stock Company. He also managed English and American stars and theatrical companies. He has allied himself closely with the so-called Theatrical Trust, formed by his brother Charles Frohman. At present he is proprietor of the (new) Lyceum Theatre, New York, and vice-president of the Famous Players' Film Company, and president of the Actors' Fund of America.

FROHSCHAMMER, Jakob, German theologian and philosopher: b. Illkofen, 6 Jan. 1821; d. Bad Kreuth, Bavaria, 14 June 1893. He studied theology at Munich, and was destined by his parents for the Roman Catholic priesthood, which he entered in 1847. From 1855 until his death he was professor of philosophy at the University of Munich. He was specially attracted to philosophy and the history of dogma. In 1850 he published his 'Beiträge zur Kirchengeschichte,' which was placed on the Index Expurgatorius, and led to his resignation as preacher at the university. His 'Über den Ursprung der menschlichen' (1854) and 'Menschenseele und Physiologie' (1855) gave great offense to his ecclesiastical superiors. In most of his writings he maintained the independence of science, whose goal was truth, against authority. He was denounced by the pope in an apostolic brief of 11 Dec. 1862, and students of theology were forbidden to attend his lectures. He refused to associate himself with the Old Catholic movement, and founded in 1862 the *Athenäum* as the organ of Liberal Catholicism. For this he wrote the first adequate account in German of Darwin's theory of natural selection, for which he was warmly commended by Darwin himself. He was excommunicated in 1871, and in reply wrote three pamphlets which were widely popular — 'Der Fels Petri in Rom' (1873); 'Der Primat Petri und des Papstes' (1875) and 'Das Christenthum Christi und das Christenthum des Papstes' (1876). He also vigorously opposed the materialism of Strauss and the doctrine of papal infallibility. In his later years he wrote several philosophical works, which include 'Die Phantasie als Grundprincip des Weltprocesses' (1877); 'Über die Genesis der Menschheit und deren geistige Entwicklung in Religion, Sittlichkeit und Sprache' (1883), and 'Ueber die Organization und Cultur der menschlichen Gesellschaft' (1885). Consult Attensperger, A., 'Jakob Frohschammer's philosophisches System im Grundriss' (1899); Friedrich, J., 'Jakob Frohschammer' (1896), id., 'Systematische und kritische Darstellung der Psychologie J. Frohschammers' (1899); Hinrichsen's, A., 'Deutsche Denker' (1888).

FROHSDORF, or **FROSCHDORF**, Austria, village situated 30 miles south of Vienna, on the Leitha. After 1844 it was the residence of the Duchess of Angoulême and later of the Count de Chambord. It subsequently became the headquarters of the elder Bourbons. Pop. about 700.

FROISSART, Jean, zhoṅ frwä-sär or froi'-särt, French chronicler: b. Valenciennes, Hainault, 1333 or 1338; d. Chimay about 1419. He was well educated with the view of entering the church, but he soon abandoned this object and took great delight in tales, adventures of chivalry and narratives of travel. His passion for travel brought him to Avignon and subsequently to England. In 1361 we find him in London, where he was appointed secretary of Queen Philippa. He visited Scotland in 1365 and in the following year left Britain with the Black Prince. Two years afterward he was in Italy. From 1370 to 1380 he lived more or less in seclusion, engaged on his Chronicles. About 1384 he was made chaplain to Guy de Châtillon, count of Blois. Thereafter for many years he made several journeys to examine the theatre of the events he was about to relate. In 1394 he was again in England and thereafter his movements became obscure. His 'Chronicle' (as the title is usually abbreviated) covering the years 1326–1400, is of capital importance for its period. To a collection of the verses of Wenceslaus of Brabant, Froissart added some of his own, and gave to the whole the title 'Meliador, or the Knight of the Golden Sun.' All of his extant poems were published at Brussels (1870–72). (See FROISSART'S CHRONICLES). Consult Darmesteter, 'Froissart' (1894); Molinier, 'Les sources de l'histoire de France' (Vol. IV, Paris 1904).

FROISSART'S CHRONICLES. The 'Chronicles' (*Chroniques*) of Froissart deserve in many respects to hold the first place among historical compositions of their kind. They purposed to be a record of all that was memorable in the long struggle between France and England that filled the last three-quarters of the 14th century, so far as it could be discovered by a man with a prodigious curiosity and thirst for information and very fortunately placed for securing it. For their author enjoyed the protection of Philippa of Hainaut, queen of Edward III, from his arrival in England in 1361 till her death, and later had successively as patrons, Duke Wenceslaus of Luxembourg and Count Guy of Blois; he lived in the company of great lords and ladies; he traveled much in England, Scotland, France and Italy; he followed the Black Prince to Aquitania in 1367 and the Duke of Clarence to Milan in 1368. Born in the 19th century Froissart would have been the prince of reporters and interviewers. He had a very keen scent for a "story," and a sharp eye for the color and movement of the life of camps and of courts, which he knew thoroughly and loved passionately. He shared unquestioningly the rather hollow ideals of knighthood of that troubled, post-chivalric age, bequeathed by the generations that had created the romances of chivalry but gone to seed and emptied of their first inspiration. The interest of life appears in the Chronicles, as in those romances, to centre in adventure. Personal exploits, feats of arms, jousts, tournaments, pageants, the glitter of armor and the clash of lance and sword and spear fill their pages and are reported with such spirit, zest and relish that they live again with vivid and colorful reality. And in equal measure the persons led in endless procession before us are made alive and real. The portraits, sketched in bold, firm, rapid, telling lines, distinct both in outward form and spiritual features, are almost the most solid and admirable part of the work. But the Chronicles are no true history. Froissart, though sincerely anxious to present the truth, was quite without critical sense, and we must not look in his pages for exact facts of date and place, which are not infrequently sadly distorted. He was equally without historical vision, and his narration wholly lacks perspective and illuminating glimpses into the meaning of the events of which he was the spectator. Chameleon-like, he takes on the color of the opinions that surround him, now English and Burgundian (in the first book of the Chronicles, inspired by Philippa of Hainaut and composed mainly in England), now French (in the three other books, and in a later redaction of the first, undertaken when his patron was French). Living in the society of the nobility he has their attitude and point of view; he has no more interest in the unprivileged people than if they did not exist, and the Chronicles have little or no information for us as to the life and condition of the great masses or the rôle they were playing more and more. But with all their shortcomings and omissions the Chronicles are a faithful mirror of the later 14th century and a most precious source of knowledge about it.

The manuscripts that we possess of the Chronicles represent several redactions, for Froissart was continually gathering new materials. For the first book he drew largely upon the Chronicles of Jean Lebel, even transcribing whole passages. For the expedition of the Black Prince in Aquitania he consulted the narrative of Chandos. The standard edition is that of Kervyn de Lettenhove (29 vols., Brussels, 1870–77). The Chronicles have long been accessible to English readers in translation.

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FROLIC, The. See WASP AND FROLIC.

FRÖLICH, Lorentz, Danish artist: b. Copenhagen, 1820; d. 1908. He studied in his native city under Eckersberg, in Dresden and in Paris under Coutoure. He spent much time in Rome and Paris and exhibited regularly at the salons. After 1877 he was professor at the Copenhagen Academy. His best known pictures are 'King Harold Blaatand' (1840); 'Cupid and the Water-Sprite' (1845; now in Leipzig); 'The Wood-God and his Family,' and decorations in several public buildings of Denmark and in the Court of Appeals at Flensburg, Prussia. He executed etchings for Fabicius, 'History of Denmark'; for Apuleius, 'Cupid and Psyche'; for 'Die Götter des Nordens' and other works. He is perhaps best known for his illustrations of old Danish ballads and of children's books.

FROLLO, Roman knight and governor of France, who was killed by King Arthur, according to an Arthurian legend of the 15th century.

FROME, England, town on the Frome, in Somersetshire, about 12 miles southeast of Bath. There are manufactures of woolen goods, broadcloth, silks, hats, dyestuffs, ales, cutlery and ironware. It is also an important central market for agricultural produce. Selwood Forest, a part of which is still in existence, was in the neighborhood. The town contains an art school and a museum and owns its water system. Pop. 10,901.

FROMENTIN, frō-mŏṅ-tăṅ, **Eugène,** French painter: b. La Rochelle, 24 Oct. 1820; d. Saint Maurice, near La Rochelle, 27 Aug. 1876. He began life as a law student, but early turned his attention to landscape painting, working in the studio of Louis Sabat. In 1842 he traveled in Algeria, and it was after this journey that under the guidance of Marilhat, the painter of Oriental scenes, he resolved to work a new vein in the same department by painting the North African deserts. In 1847 he exhibited at the Salon for the first time and visited Algeria twice (1848–52). The fruits of these wanderings were not only numerous pictures, but also two literary works descriptive of his travels. These were 'A Summer in the Sahara' (1856), and 'A Year in the Sahel' (1858), works distinguished by powerful and richly colored style and poetic imagination. As a painter his aim was to depict the light and atmosphere of the desert with truth and delicacy, yet imparting to it his own subjective interpretation, and he showed a marked taste for studies in gray and violet. The masterly analysis of ancient painting, which appears in his 'Masters of a Former Day' (1876), embodies the results of his travels in Holland and Belgium (1875), where he made a careful study of the Dutch and Flemish masters. His paintings are remarkable for their brightness and harmony of color, excellent draftsmanship and execution. The most noted are 'A La Rochelle Farm' (1847); 'The Gazelle Hunt' (1857); 'A Street in El-Aghouat' (1859); 'An Arab Bivouac'; 'The Falcon Hunt' (1863); and 'An Arab Camp,' his last picture, in the Louvre. He is represented in the Walters collection, Baltimore, and in the Vanderbilt collection and the Metropolitan Museum, New York. Consult Blanchon, 'Biography and Letters of Eugène Fromentin' (1909); Claretie, "Eugène Fromentin" (in 'Peintres et sculpteurs contemporains,' Paris 1882); Gouse, 'Eugène Fromentin, peintre et écrivain' (ib. 1881); Huthor, 'Modern Painting' (New York 1907); Jouin, "Fromentin" (in 'Maitres contemporains,' Paris 1887).

FROMMANN, Georg Karl, German philologist: b. Coburg 1814; d. 1887. He was editor of *Die deutsche Mundarten* and was also librarian of the Germanic Museum. In 1865 he was one of a Committee of Eleven theologians, which undertook the revision of Luther's translation of the New Testament. Later, at the request of the Protestant conference, the Old Testament was included and the revised edition of the whole Bible was published in 1892. Consult memoir by Vogt (Nuremberg 1888).

FROMMEL, frŏ'mĕl, **Emil,** German theologian and author: b. Karlsruhe, 5 Jan. 1828; d. 1896. He was educated at Halle, Erlangen and Heidelberg. He held several pastorates successively, was army chaplain during the struggle with France in 1870–71 and after the war became court preacher at Berlin and pastor of the garrison there. He wrote several volumes of theology including 'Die zehn Gebote Gottes in Predigten' (6th ed., 1898); 'In drei Stufen,' an anthology, (8th ed., 1890); 'Festflammen' (6th ed., 1896); 'Das Gebet des Herrn in Predigten' (4th ed., 1893). 'Tales For the People' (1873–86), and similar collections of humorous and realistic compositions, will more surely form his memorials in the future.

FROMMEL, Karl Ludwig, German painter and engraver: b. Birkenfeld, Oldenburg, 1789; d. 1863. He studied at Karlsruhe where his masters were F. J. Becker and Haldenwang. He afterward visited France and Italy. He returned to Germany in 1817, and became professor at Karlsruhe, where he founded the Society of Art and Industry. He visited London in 1824 with the object of studying the technique of steel engraving, and later he established a studio in this branch at Karlsruhe. He was director of the picture gallery from 1830 to 1858 and his able administration placed it in a flourishing condition. His most notable works (engravings) are 'Arricia near Rome'; 'View of Tivoli'; 'Mount Ætna'; and 'Mount Vesuvius.' Many of his landscapes are preserved in the Karlsruhe gallery.

FROMMEL-LINDEMANN, Karl August. See LINDEMANN-FROMMEL.

FROND, *in botany,* a term applied to a plant in which stem and leaves are not differentiated. It has been generally applied to fern leaves by older botanists who thought that ferns represented a combination of stem and leaf. The duckweed is the best illustration of the frond type.

FRONDE, frôṅd, the name of a political faction which played a conspicuous part in French history during the minority of Louis XIV, and gave rise to the insurrectionary movement known historically as the War of the Fronde. The members of this party obtained the contemptuous name of Frondeurs (slingers), being compared to boys throwing stones from slings, owing to the pertinacious lampoon warfare which they waged against the powerful minister of that day, Cardinal Mazarin, and the Queen Regent, Anne of Austria. Mazarin, as a foreigner and a parvenu, was detested by the French people — both patrician and proletarian — and especially had incurred the opposition of the Parliament of Paris to his measures. In 1648 Mazarin ventured on the bold step of arresting two of the most popular members of the latter body, and on the next day, 27 August (*la journée des barricades*) the Parisians rose in arms, dispersed some of the royal troops sent out against them, and barricaded the approaches to the Louvre, compelling the court party to retire to Saint Germain, thus leaving Paris in the hands of the insurgents. Upon the Prince de Condé advancing to besiege the capital, the parliament called the citizens to arms, when the Prince de Conti, the Duc de Beaufort («Le Roi des Halles,» and son of Henry IV), and numerous others of the great nobles of the kingdom came forward to head the insurrection. The famous Cardinal de Retz and the Duchesses de Longueville and de Montbazon also joined the popular cause. The Prince de Condé, too, changed sides and went over to the malcontents, with whom the court party shortly afterward patched up a treaty of peace of but brief duration. Fresh contentions arose, and Mazarin caused the arrest of Condé and Conti. This step excited a revolt in the provinces, and Marshal Turenne hastened to the rescue of the Frondeur princes, but was routed in the battle of Rethel (1650). The cardinal, however, enjoyed but a temporary supremacy; the parliament again agitated against him, and procured his banishment from France, leaving the Prince de Condé master of the situation. Subsequently, the contest degenerated into a war of intrigue and is regarded as one of the most useless conflicts ever waged. The court finally agreeing to dismiss Mazarin a general amnesty was proclaimed. Condé attempted to continue the struggle, but was proscribed, and entered the service of Spain, while Mazarin, after a time, returned to Paris, and again obtained the reins of government. It was not until 1653 that the last signs of revolt in the provinces were suppressed. The defeat of the movement helped to render the monarchy absolute. Consult Barante, ‹Le parlement de Paris et vie de M. Mole› (Paris 1859); Gordon, ‹The Fronde› (Oxford 1905); id., ‹Lettres du Cardinal Mazarin› (Paris 1878–1906); Pardoe, ‹Louis XIV and the Court of France, etc.› (London 1888); id., ‹Memoirs of Cardinal de Retz› (ib. 1896); Perkins, ‹France under Richelieu and Mazarin› (New York 1888).

FRONSPERG. See FRUNDSBERG, GEORG VON.

FRONSPERGER, Leonhard, German military writer: b. Ulm 1520; d. 1575. He applied himself to the study of military science at an early age. His most famous work is the ‹Kriegsbuch kaiserlicher Kriegsgerechte und Ordnungen vom Geschütz› (1573; new ed., by F. W. A. Böhm 1819), in which is displayed a remarkable knowledge of military science in all its ramifications. It stamped Fronsperger at once as the foremost German military writer of his century.

FRONT ROYAL, Engagement at. Front Royal, Va., is 12 miles east of Strasburg, and is the key to Luray Valley. On 23 May 1862 it was held by Colonel Kenly with nine companies of the 1st Maryland infantry, two companies of the 29th Pennsylvania, a company of the 28th New York, and a section of Knap's battery, under command of Lieutenant Atwell, in all about 900 men. Soon after noon of the 23d «Stonewall» Jackson, moving down the Luray Valley to cut off Banks' retreat from Strasburg to Winchester, pushed through the town, driving in Kenly's pickets and advance-guard. Kenly made a stand on a ridge about a mile north of the town, where he was joined by about 100 men of the 5th New York cavalry, but was soon flanked and pushed across both branches of the Shenandoah, and failed to burn the bridges behind him. When across the river he drew up on its north bank and, with artillery and musketry, resisted for some time all efforts to cross; but Jackson's cavalry forded the stream, both above and below the bridges, thus flanking his position, and Kenly fell back toward the cross-road leading to Middletown, closely followed by Confederate cavalry. He had gone four miles when his cavalry rear-guard was stampeded, and his infantry fiercely attacked, the resistance continuing until his force was cut to pieces and captured, with Atwell's two guns and the entire supply-train. Nearly all the New York cavalry escaped. The Union loss was 18 killed, 56 wounded and 718 captured; the Confederate loss was 11 killed and 15 wounded. Jackson pushed on after Banks, leaving Colonel Conner with the 12th Georgia and a battery at Front Royal. On the 30th the 1st Rhode Island cavalry, the advance of McDowell's corps, dashed into the town, surprised Conner, and captured 156 officers and men and one gun, the loss in the cavalry being 8 killed and 5 wounded.

FRONTAL BONE. See SKULL.

FRONTAL MORAINE. See MORAINE.

FRONTAURA, frōn-tă-oo'rä, **Vásquez Carlos,** Spanish dramatist and journalist: b. Madrid, Spain, 4 Sept. 1835. He was one of the most voluminous writers of Spain in the 19th century and contributed to practically all the well-known newspapers and magazines of Madrid. He founded the *Cascabel,* which he used in behalf of the restoration to the throne of Spain of Alfonso XII, in which he was finally successful. He became president of the Council of Ministers, and for six years he was governor of various provinces, editor-in-chief of the *Gaceta de Madrid* and finally head of the section of public charities in the Department of the Interior, a position he held for many years. He wrote many dramas and musical comedies, several of which were very popular and are still played wherever Spanish is spoken. Two of his zarzuelas, ‹Un caballero particular› and ‹En las astas del toro› have been presented almost countless numbers of times in Spain and the Spanish-American countries. Among his numerous comedies, ‹Pepe Carranza› and ‹Las tres rosas,› have also been extraordinarily popular. Among his other works which have been widely read are ‹Las tiendas,› ‹Los sermones de Doña Paquita,› ‹Tipos madrileños,› ‹La Galería de Matrimonios,› ‹Miedo al hombre,› ‹Brígida.› In all, his novels, stories and humorous works number little short of 100. He also published ‹Los Niños,› a magazine collection of stories for children (14 vols.), the best of its kind in Spain. His writings dealing with national customs contributed to *La Ilustración Española y Americana* show a real insight into the life of certain classes of Spain. He has also written several books for children which became very popular. Many of his works of all kinds have been translated into Portuguese, French, German and Italian.

FRONTENAC, Louis de Buade, loo-ē dė boo-äd frônt'näk, COMTE DE, French colonial officer: b. France, 1620; d. Quebec, 28 Nov. 1698. He entered the army in 1635 and at an early age became brigadier. In 1672 he was appointed governor of the French possessions in North America. Of an imperious nature, the new governor was nevertheless most energetic and aimed at an orderly, well-directed administration of the colony, which he believed would herald an era of great prosperity. To this end he inaugurated a city administration in Quebec and convened the clergy, nobles and commons. Frontenac's reforms met with little favor from his sovereign and he was shorn of much of his power. Quarrels with the Jesuits, the new intendant and the governor of Montreal divided the colony, and the news spreading to France Frontenac was recalled in 1682. In spite of his violent temper he gained the confidence of the settlers and the respect of the Indians, and in 1689, when to the horror of constant attacks from the Iroquois the misery of a war with England was added, he was again sent out by the king, as the only man who could rouse the colonists to hope and action. During the next nine years he loosed his savage allies on the defenseless villages of New England, repulsed a British attack on Quebec and so broke the power of the Iroquois that they were never again a terror to the colony. Consult Le Sueur, 'Count Frontenac' (Toronto 1906); Parkman, 'Frontenac and New France Under Louis XIV' (1877); Winsor, 'Cartier to Frontenac' (1894).

FRONTENAC, Kans., city of Crawford County, on the Atchison, Topeka and Santa Fe, the Kansas City Southern and other railroads, 100 miles south of Kansas City. It is the centre of an important coal mining region. The waterworks are the property of the municipality. Pop. 3,396.

FRONTERA, Mexico, a seaport in the State of Tabasco on the Gulf of Campeachy, 225 miles southeast of Vera Cruz. It has a good harbor and its annual exports exceed $2,000,000, consisting chiefly of coffee, cocoa, hides, rubber and dyewoods. Its imports consist chiefly of iron, steel, machinery and cotton goods and are valued at about $1,000,000 annually. It is the port of Juan Bautista, the capital of the State of Tabasco. A United States consul is stationed here. Pop. 5,760.

FRONTIER, Military, the outermost limits of the lines of national defense of a country. By agreement between countries with a common land frontier the military frontier is placed at some distance back of the actual dividing line between them. The term was formerly applied to a narrow strip along the Turkish frontier in Hungary, which had a special military government. Modern land frontiers are usually defended by a chain of forts.

FRONTINUS, frŏn-ti'nŭs, **Sextus Julius,** Roman writer of the latter part of the 1st century after Christ. He was thrice consul and commanded with reputation in Britain under Vespasian. He was appointed by Nerva to superintend the aqueducts of Rome and left an extant work on the subject, 'De Aquis Urbis Romæ,' as well as one dealing with the art of war, 'Stratagemata.' His death took place about the year 105 A.D. The 'De Aquis Urbis Romæ' is an important work in that it contains complete descriptions of the aqueducts and water supply of the city. Consult Herschel, 'Two Books on the Water Supply of the City of Rome,' which contains an edition of 'De Aquis,' with translations, notes and commentary (Boston 1899; 2d ed., London 1913) and 'Stratagemata,' edited by Gunderman (Leipzig 1888).

FRONTO, Marcus Cornelius, Roman orator and rhetorician: b. Cirta, a Roman colony in Numidia, about 100 A.D.; d. about 175. He went to Rome during the reign of Hadrian, soon acquired great fame as a speaker and teacher of rhetoric and was in consequence selected as tutor to M. Annius Verus and L. Commodus, afterward emperors under the names of Marcus Aurelius and Lucius Verus. He became a member of the senate and was a consul in 143 A.D. Till 1814 the only extant writings of Fronto were a worthless tract, 'De Differentiis Vocabulorum' and some fragments; but in that year Angelo Mai recovered many of Fronto's letters from a palimpsest in the Ambrosian library at Milan. These were part of the orator's correspondence with Antoninus Pius, Marcus Aurelius, Lucius Verus and other distinguished friends and were published under Mai's editorship in 1815. In 1823 Mai published a new edition of the letters, containing many others which he had discovered in the Vatican library. While not of great importance the letters show that the Emperor Marcus Aurelius was as highly esteemed by his contemporaries as by the moderns. Consult edition of the letters by Naber (Leipzig 1867); Brock, 'Studies in Fronto and his Age' (Cambridge 1911); Ellis, 'The Correspondence of Fronto and Marcus Aurelius' (Oxford 1904); Teuffel, 'Geschichte der römischen Litteratur' (6th ed., Leipzig 1913).

FROSCHDORF. See FROHSDORF.

FROSINONE, frŏ'sĭ-nō'nē, Italy (the ancient FRUSINO), city in the province of Rome, 53 miles southeast of Rome, on the Cosa River. Wine is produced in the neighborhood and marketed here. The ruins of the ancient Volscian town form its principal attraction. Pop. (commune) 11,646.

FROSSARD, Charles Auguste, French military officer: b. Versailles, 1807; d. Château-Villain, Haute Marne, 25 Aug. 1875. He was educated at the military school of Metz and gained distinction in the engineers' corps. He was present at the siege of Rome in 1849, was commander of the Second Corps of Engineers in the Crimea, and was made a brigadier-general in 1855. He served as chief of the engineering department in Italy in 1859 and in 1867 received the appointment of chief of the military household and governor to the prince imperial. He commanded the Second Corps of the Army of the Rhine in the Franco-Prussian War, driving the Prussians from Saarbrücken on 2 Aug. 1870. On 6 Aug. 1870 he was defeated at Forbach. He gave the order for the charge of the Imperial Guard cavalry in an effort to stem the retreat at Metz on 16 August, and was involved with his corps in the surrender of Bazaine's army, remaining a prisoner until the close of the war. General Frossard published a 'Rapport sur les operations du 2e corps de l'armée du Rhin dans la campagne de 1870' (Paris 1872).

FROST, Arthur Burdett, American illustrator and author: b. Philadelphia, 19 Jan. 1851. He studied under Thomas Eakins in the Academy of Fine Arts, Philadelphia, and coming to New York secured employment on the *Graphic,* and later entered the studio of Harper and Brothers, where his associates were Abbey, Reinhart and Alexander. In 1877 he went to England, and in 1900 he exhibited at the Paris Exposition. His early work was full of interest and attracted much attention and his later work showed the spirit of the true artist. His illustrations of 'Out of the Hurly-Burly' (1872), first attracted general attention. Good examples of his style are his illustrations of Stockton, 'Rudder Grange' (1879); Thanet, 'Stories of a Western Town' (1893); and Bunner, 'Story of a New York House' (1887). He has published 'Stuff and Nonsense' (1888); 'Bull Calf and Other Tales' (1892); 'Sports and Games in the Open' (1899); 'Golfers' Alphabet'; 'Book of Drawings' (1905); 'Carlo' (1913).

FROST, Edwin Brant, American astronomer: b. Brattleboro, Vt., 14 July 1866. He was graduated at Dartmouth in 1886 and afterward studied physics and astronomy at Princeton, Strassburg and at the Royal Astrophysical Observatory at Potsdam, Germany. In 1887-90 he was instructor in physics and astronomy, 1892-95, assistant professor and director of the observatory, 1895-98, professor of astronomy, and from 1898 to 1902 non-resident instructor at Dartmouth College. In 1898 he was appointed professor of astrophysics and in 1905 director at the Yerkes Observatory of the University of Chicago. From 1896 to 1902 he was assistant editor and after 1902, editor of the *Astrophysical Journal.* He has made an especial study of stellar velocities, stellar spectroscopy, sun spots and solar thermal radiation. He is a member of the National Academy of Sciences, the Royal Astronomical Society, the Societá degli Spettroscopisti Italiani and of many other learned bodies. He translated, revised and enlarged J. Scheiner's 'Treatise on Astronomical Spectroscopy' (1894), and has made many contributions to astronomical and other periodicals.

FROST, George Henry, American publisher: b. Ontario, Canada, 9 July 1838. He was educated at McGill University, Montreal, where he was graduated civil engineer in 1860. He was a land surveyor and railway engineer in Chicago before establishing himself in New York in 1878. In 1874 he established the *Engineering News* and published it until August 1911, when it was sold. He is president of the Courier-News Publishing Company of Plainfield, N. J., and is member of many engineering societies.

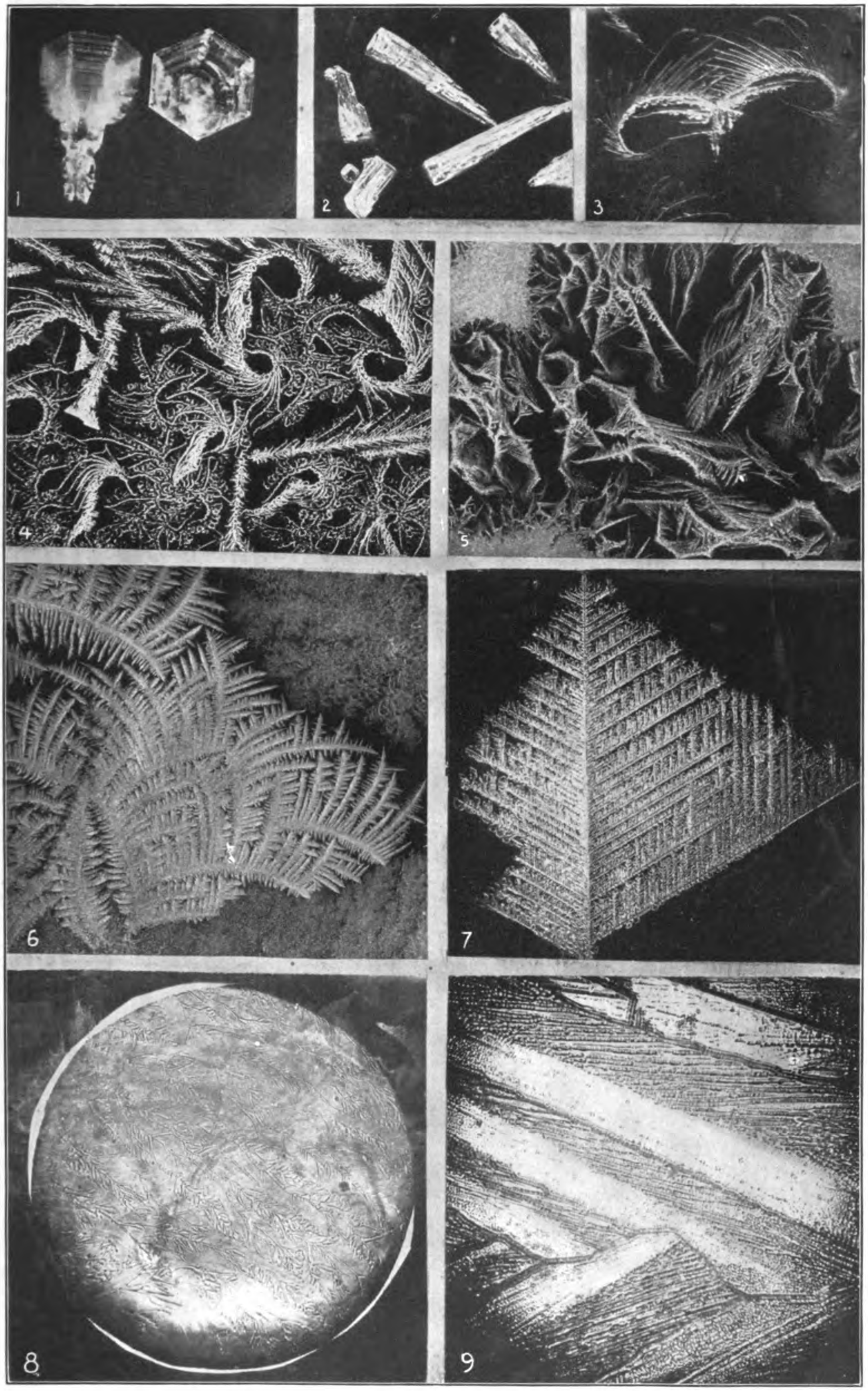
FROST, John, American educator and writer: b. Kennebunk, Me., 1800; d. 1859. He was educated at Bowdoin and at Harvard, being graduated at the latter in 1822. He taught in Boston and from 1828 to 1838 conducted a girls' school in Philadelphia. He was later connected with the Central High School until 1845. He compiled many school books and biographical and historical works, including his very popular 'Pictorial History of the United States' (2 vols., 1844); 'Pictorial History of the World'; 'Lives of American Generals'; 'American Naval Biography,' etc.

FROST, William Edward, English painter: b. Wandsworth, near London, September 1810; d. 4 June 1877. About 1825 he was sent to a drawing school in Bloomsbury where he studied for several years. He also studied in the British Museum and in 1829 was admitted as a student in the Royal Academy schools. He maintained himself all those years by portrait-painting, executing over 300 portraits. In 1839 he was awarded the gold medal of the Royal Academy for his 'Prometheus Bound.' In 1843 he was awarded a third-class prize for his cartoon 'Una alarmed by Fauns and Satyrs.' His best-known works are 'Christ crowned with Thorns' (1843); 'Nymphs dancing' (1844, now in the Dublin Museum); 'Sabrina' (1845); 'Diana and Actæon' (1846); 'Nymph disarming Cupid' (1847); 'Una and the Wood-Nymphs' (1847); 'Chastity' (1854); 'Il Penseroso' (1855); 'The Graces and Loves' (1863); 'Hylas and the Nymphs' (1867). In 1846 he was elected an associate of the Royal Academy, and to full membership in 1871. Frost was deficient in power of design and while many of his works have grace and charm they are entirely without mastery. Many of his pictures were frequently engraved.

FROST, William Goodell, American educator: b. Le Roy, N. Y., 2 July 1854. He was graduated at Oberlin College in 1876, and afterward studied at the universities of Wooster, Harvard and Göttingen, Germany. From 1877 to 1879 he was instructor in Greek, and from 1879 to 1892 professor of Greek at Oberlin, being chosen president of Berea College in the latter year. He has done much in the promotion of higher education in Kentucky and in adapting educational methods to conditions in the Southern mountains. He published 'Greek Primer' (1887); 'Inductive Studies in Oratory' (1890), and contributions to magazines.

FROST, the moisture in the atmosphere crystallized or congealed by the cold, upon the earth's surface, or upon various objects and surfaces situated or existing upon it, as grasses, shrubs, trees, window panes, etc. The various phenomena of hoar frost, window frost, etc., grouped under this head, occur over a large portion of the land surface of the earth. In the United States, hoar frosts often occur during the spring and autumn months, over the whole northern portion of the country, and more rarely also in the Southern States, sometimes causing much damage by freezing and injuring the young corn sprouts and early fruits and vegetables. Frosts occur only during calm, cold nights when the temperature falls below 32° F. In the United States the meteorological conditions usually preceding the formation of frosts are northerly winds, accompanied by high barometer, and especially the coincidence of these conditions with the near approach, or passing, of a storm from the west or southwest. The formation of hoar frost depends in some degree upon surface topography and local causes, oc-

WINDOW AND HOAR FROST



1 Columnar window frost
2 The same, cup-like
3, 4, 5, 7 Crystalline window frost
6 Branching hoar frost
8, 9 Membranous window frost, highly magnified

curring much more frequently within the deep valleys leading down from mountain heights, than in broader valleys or level regions. In the former, during calm cold nights, the cold air of the hill and mountain tops, by virtue of its greater specific gravity, flows down and mixes with, or flows underneath and replaces, the warmer, lighter air of the valleys, thus furnishing the conditions favorable to frost formation. The cooling of objects by radiation of heat, and by the evaporation of moisture from them, greatly facilitates the formation of frost. Frost crystallizations exhibit a wonderful variety, both of form and structure. The formation of each of the various types seems to depend upon a great number of meteorological and other conditions, some of them obscure. The temperature of the air, its electric condition, humidity, etc., and also the nature of the substances upon which they form, each seem to exert an influence in determining and modifying their form and structure. Two principal types of hoar frost occur,— the columnar and the tabular. Commonly, both varieties do not occur simultaneously, but on a given night one or the other type will greatly predominate and form the bulk of the crystals. Frost crystallizations in general greatly resemble those of snow, but because their development is usually restricted in one or more directions by the objects or surfaces upon which they form, the resemblance is segmentary, rather than complete. In general, columnar forms vary from similar snow crystallizations, by virtue of their hollow cylindrical, or cup-like character, and by often attaining to much greater dimensions. Sometimes, during extreme cold, such forms attain a length of many inches. Tabular forms rarely attain perfect symmetry, but exhibit within them air tubes and inclusions, assume crystal forms possessing both close and open structure, and develop upon the same extremely thin plane as do similar snow crystals. As commonly deposited in spring or autumn, they do not usually greatly exceed in size similar snow forms, but during intense and prolonged cold, as in winter, they attain much greater dimensions. A very beautiful effect is sometimes produced by the deposition upon the trees, shrubs, etc., of a heavy coat of hoar frost. Each limb and leaf and delicate twig is transformed and beautified, and presents a white appearance, as though frosted with silver. During zero weather, large and delicately formed branching tabular crystals, and long, icy needles, form in beautiful pendent clusters upon, and depend from, the rafters and timbers of barns, etc., close to where domestic animals are kept; and also upon ferns and similar plants overhanging icy terraces or ice-covered pools. Similar forms also form directly upon or project from icy surfaces. Even the clouds furnish their quota of frost crystallizations. When low-lying clouds enshroud mountain tops covered by forests, they often deposit a portion of their moisture upon the branches of the trees, commonly in the form of long, granular or fibrous needle-shaped crystals. Fogs, when they occur during hoar frost formation, usually deposit moisture upon the forming crystals in granular form. The most beautiful and varied frost crystallizations are those that form upon the window panes of dwelling houses, etc., in arctic or temperate zones. These fairy-like creations, seemingly in imitation of leaves, feathers, ferns, trees, starry firmaments, tropical forest effects, etc., occur as three distinct entities: the granular, the crystalline, and the membraneous. The latter variety forms only in heated rooms, upon window panes covered with an uncongealed film of water, as a dew-like condensation of moisture. It occurs most frequently in the form of long, curving, feather-like forms, or as an exceedingly delicate membranaceous-like network of diverging and coalescing lines. It is due to a process of crystallization that takes place during the conversion of a film of water into ice. The crystalline variety of window frost forms only upon window panes that are free from water in liquid form. Crystals of this class assume branching, star-like forms (often as four- or six-pointed branching stars), curving filaments, fibrous crystallizations, and those resembling sea-moss, long serrated lines, etc. Many of these are very beautiful and interesting. Some of them develop within minute striations in the surface of the glass and will reappear in the same identical positions upon a given pane, with each renewal. When identical meteorological and other conditions recur again and again, the types of frost coexistent with each will, in general, recur simultaneously with them. During zero weather, if conditions are favorable, the formation and growth of these beautiful frost creations takes place very rapidly. A beautiful and absorbingly interesting experiment consists in melting a heavy coat of window frost off a portion of a window pane (by placing an oil lamp close to it). Only the central portion of the pane should be cleared of all moisture; around this a film of water should be left upon the glass. Soon after the lamp is removed the feather-like membraneous frost will form around the outer edges of the film of water, and quickly radiate in beautiful curves toward the centre of the pane. They stop instantly when they reach the clear glass. Soon minute and delicate serrated crystal lines, or tiny crystal stars, appear upon the clear glass space, and slowly develop, and usually coexistent with them a thin film of granular texture will be laid down upon portions of the clear glass. The latter is not usually deposited in slow progressive order, but in intermittent order. Large spaces of the clear glass are often covered simultaneously, by a succession of auroral-like flashes; each flash, in the twinkling of an eye, spreading a thin granular film upon unoccupied portions of the glass. Singularly enough, the granular deposit does not form near where the true crystalline frost is; the latter repels the former and prevents its formation upon the spaces immediately surrounding it.

The phenomena included under the title frost, as commonly accepted, are understood to include both the processes of freezing and the mechanical effects produced thereby. Considered under this broad definition, frost plays an important part in the economy of nature, both beneficent and otherwise. It enters the crevices and minute cracks in the rocks and rends the rocks apart; and is thus an important agent in aiding and hastening their disintegration, and in converting them and the solid materials of the earth into soil. Its beneficent action in loosening and pulverizing the soil, by entering it and forcing the particles of compacted soil and clods apart through its expansive action upon the particles of moisture disseminated therein, is well known, and is of inestimable value to agriculture and to humanity. The damage sometimes done to vegetation, trees, etc., through the frosts entering them, and rending their fibres, cells, etc., apart, is often very great, and partial failures of crops such as corn, vegetables, fruits, etc., are due to this cause. As any considerable motion of air, the presence of clouds covering the sky, or the placing of a light covering, as of cloth or similar material, over the objects to be protected, greatly reduces or prevents the formation of frost upon them and of injury thereby, artificial preventives are often resorted to. Sometimes smoke-producing fires are built around or within enclosures or fields containing plants, fruits, or vegetables, and light, tent-like coverings are placed over small fruit trees, shrubs, etc., and other tender vegetable or plant growths, and thus the damage by frosts is prevented, or minimized. In France an instrument has been devised for the prediction of frost. It consists of a wet bulb and dry bulb thermometer, mounted on a board on which is also a scale of lines corresponding to the degrees of the dry bulb, and a pointer traversing a scale graduated according to degrees of the wet bulb. Observations are taken shortly before sunset. By means of the pointer and scale, the point may be found at which the line of the dry bulb reading meets the pointer set to the reading of the wet bulb. The scale is colored so that the point may fall in one of three zones, indicating certain frost, probable frost or no probability of frost. See also SNOW.

Air Drainage is a term generally applied to a type of air circulation which plays an important part in the distribution of frosts, more particularly in hill and valley districts. The cold heavy air of the higher slopes flows down and fills the valley, forcing upwards the warm and lighter air of the latter, and forming in the valley a lake of cold air. Thus there are heavy frost in the valleys while the higher slopes escape. The condition is understood by gardeners and others who use upper slopes for their gardens, orchards, etc.

Bibliography.—Andrews, 'Famous Frosts and Frost-Fairs in Great Britain' (London 1887); Beals, 'Forecasting Frost in the North Pacific States' (Weather Bulletin 41, Washington 1912); Cox, 'Frost and Temperature Conditions in the Cranberry Marshes of Wisconsin' (ib. 1910); Day, 'Frost Data of the United States and Length of the Crop-Growing Season' (ib. 1911); Garriott, E. B., 'Cold Waves and Frost in the United States' (Weather Bulletin P, Washington 1906); 'Canada's Fertile Northland' (Department of the Interior, Ottawa 1907); Hann, 'Zum Klima Manitoba' in *Meteorologische Zeitschrift* (Vienna 1894), and *Monthly Weather Review*.

FROST-BIRD, or FROST-SNIPE, a stilt sandpiper (q.v.).

FROST-BITE, form of mortification due to the action of cold in withdrawing the supply of blood from ears, fingers, nose, toes, cheeks, etc. In its milder forms it is known as «chaps» or «chilblains.» In frostbite the affected parts are always in danger of gangrene. The remedy is an immediate application of snow or a spray of ice-water to restore the circulation; this cold application is effective in all cases where the mortification is slight and not of long duration, but if it has gone too far the circulation cannot be restored, the part is lost and surgical treatment of the latter is necessary to prevent a spread of gangrene. See CHILBLAIN; COLD.

FROST-FISH, a name given to various fishes, because they appear at the time of early frost, as does the tomcod (q.v.) so called in New England. The frost-fish of New Zealand is one of the scabbard-fishes (q.v.).

FROSTBURG, Md., town in Allegany County, 80 miles southeast of Pittsburgh; on the Pennsylvania, the Western Maryland and the Cumberland railroads. Its situation is picturesque at an elevation of 2,200 feet above sea-level, and it has a reputation as a summer resort. A State normal school and a miners' hospital are located here. Coal mining is the chief industry, but there are also fire-brick and tile works, planing-mills, foundries and hosiery mills. It is governed by a mayor, elected for one year, and a council elected at large. The waterworks are the property of the municipality. Pop. 6,028.

FROTH-FLY, or FROTH-HOPPER. See FROGHOPPER.

FROTHINGHAM, Arthur Lincoln, American archæologist: b. Boston, Mass., 21 June 1859. He was educated in Rome, Italy, and at Leipzig; lectured on archæology at Johns Hopkins University in 1882–86; and became professor of archæology and the history of art at Princeton University in 1887, and in 1898–1906 was professor of archæology and ancient history. He founded the *American Journal of Archæology* in 1885; and was associate director of the American School of Classical Studies, Rome, in 1895–96. He is a member of many learned societies. His publications include 'A History of Sculpture'; 'Mediæval Art Inventories of the Vatican'; 'Stephen Bar Sudaili, the Syrian Mystic and the Book of Hierotheos' (1886); with Marquand, A., 'A Textbook of the History of Sculpture' (1896); 'Monuments of Christian Rome' (1908); 'Roman Cities in Italy and Dalmatia' (1910); 'A History of Architecture' (1911), and various monographs on Syria.

FROTHINGHAM, Nathaniel Langdon, American Unitarian clergyman and religious writer: b. Boston, Mass., 23 July 1793; d. there, 4 April 1870. He was graduated from Harvard in 1812 and entering the ministry was pastor of the First Church in Boston 1815–50. He was author of 'Deism or Christianity'; 'Sermons in the Order of a Twelvemonth' (1852); and 'Metrical Pieces' (1855–70). He was one of the earliest American students of German. His writings are marked by grace and refinement.

FROTHINGHAM, Octavius Brooks, American clergyman: b. Boston, Mass., 26 Nov. 1822; d. there, 27 Nov. 1895. He was a son of N. L. Frothingham (q.v.), and was graduated from Harvard in 1843, and from the Cambridge Divinity School in 1846. His radical views led to the resignation of his pastorate in the North Unitarian Church, Salem, Mass. He was pastor in Jersey City 1855–59; he then organized the Third Unitarian Church in New York, where he preached very radical and advanced views till his resignation in 1879. The remainder of his life was devoted to travel and literary pursuits, his home being in Boston. His works were 'Stories from the Lips of the Teacher'; 'Stories from the Old Testament'; 'The Religion of Humanity'; 'The Cradle of the Christ'; 'Memoir of W. H. Channing'; 'The Safest Creed'; 'Beliefs of the Unbelievers'; 'Creed and Conduct'; 'The Spirit of the New Faith'; 'The Rising and the Setting Faith'; 'Lives of Gerrit Smith, George Ripley, Theodore Parker'; 'Transcendentalism in New England'; 'Recollections and Impressions'; etc.

FROTHINGHAM, Richard, American journalist and historian: b. Charlestown, Mass., 31 Jan. 1812; d. 1880. He was at various times a member of the State legislature, was mayor of Charlestown 1851–53, and managing editor of the Boston *Post* 1852–65. He published 'History of Charlestown' (1848); 'History of the Siege of Boston' (1849); 'Life and Times of Gen. Joseph Warren' (1865); 'The Rise of the Republic of the United States' (1871).

FROUDE, frood, **James Anthony,** English historian: b. Dartington, Devonshire, England, 23 April 1818; d. Salcombe, Devonshire, 20 Oct. 1894. He was the youngest son of Archdeacon R. H. Froude, rector of Dartington, and was educated at Westminster and Oxford. His brother, Hurrell Froude, was one of the leaders in the "Oxford Movement" and both were influenced by Newman, the earliest work of the younger Froude being a contribution to the 'Lives of the Saints,' edited by Newman. He soon emerged from Tractarian influence, however, and for the rest of his life remained indifferent to the Church in which he had been reared. The first two volumes of his history of England appeared in 1856 and at once attracted marked attention, both favorable and adverse, on account of the brilliant style and the audacity of the writer's opinions. The book flatly reversed many historical judgments, and interpreted motives in a manner more common now than then, but very startling to readers in the middle of the 19th century. His attempted vindication of Henry VIII must be accounted a failure, brilliant and able as it is, and although it is a most striking portrait of Henry that he has painted, it cannot be called a faithful likeness. His treatment of Mary of Scotland is frankly hostile, and has been met with severe criticism. His judgment of Elizabeth, though far from impartial, is more nearly accurate than that of either of the other two personages. He excelled in vigorous, dramatic presentation of men and events, and in the judgment of sober critics appears to have cared much more for picturesque narrative than for absolute historical accuracy. As a historian, he will long continue to be read and admired, but his apparent indifference to historical truth at times will not permit of his inclusion in the first rank of historians. He visited the United States in 1872 on a lecture tour, his lectures being afterward published with the title of 'English Misrule in Ireland.' In 1874 he visited South Africa, his impressions being later given to the world in lectures at Edinburgh, and in 1882 made an extended tour through Australia, the West Indies and the United States, the literary outcome of which were 'Oceana' and 'The English in the West Indies.' He was the friend of Carlyle, whose literary executor he became, and his life of the Sage of Chelsea, his 'Reminiscences of Carlyle' and 'Letters and Memorials of Jane Carlyle' have excited a vast amount of controversy. In 1892 Froude succeeded the historian Freeman as regius professor of history at Oxford, his lectures in that capacity afterward constituting his volume on Erasmus. It may be said that Froude was more distinctly a man of letters than a historian. He is always readable even when one is forced to dissent from him most strongly, but he touched on too many themes to give to the writing of history the devotion toward it so characteristic of such men as the late Samuel Rawson Gardner, Professor Freeman or John Richard Green, and he was temperamentally indifferent to the claims of entire truthfulness. He may not have consciously distorted facts, but his selection of certain details and suppression of others for the apparent sake of making the particular hero in question brighter, or the particular villain darker, does not commend itself to the lover of truth for its own sake. His important works include 'Shadows of the Clouds,' published under the pseudonym "Zeta" (1847); 'The Nemesis of Faith' (1849); 'The Book of Job' (1851); 'The History of England from the Fall of Wolsey to the Death of Elizabeth' (1856–70); 'Short Studies on Great Subjects' (1867); 'Inaugural Address Delivered to the University of St. Andrews' (1869); 'The Cat's Pilgrimage' (1870); 'Short Studies: Second Series' (1871); Calvinism' (1871); 'The English in Ireland in the 18th Century' (1872–74); 'Short Studies: Third Series' (1877); 'Life and Times of Thomas Becket' (1878); 'Cæsar: a Sketch' (1879); 'Bunyan' (1880); 'Two Lectures on South Africa' (1880); 'Reminiscences of the High Church Revival' (1881); 'Short Studies: Fourth Series' (1882); 'Reminiscences of Thomas Carlyle' (edited 1881); 'Thomas Carlyle: History of the First Forty Years of His Life' (1882); 'Letters and Memorials of Jane Welsh Carlyle' (edited 1883); 'Thomas Carlyle; History of His Life in London 1831–81' (1884); 'Life of Lord Beaconsfield' (1890); 'The Divorce of Catharine of Aragon' (1891); 'Life and Letters of Erasmus' (1894). The first two volumes named above he attempted to suppress in later life, and succeeded with 'The Shadow of the Clouds.' Consult 'Life,' by Herbert Paul (1905).

FROUFROU, comedy in five acts, produced at the Gymnase in 1869 and the greatest work of Meilhac and Halévy.

FROZEN STRAIT, the passage which connects Repulse Bay and Fox Channel, and separates Melville Peninsula and Southampton Islands. It is from 10 to 20 miles wide and in lat. 65° N. This strait is frozen, as its name indicates, nearly all the year, although some bodies of water farther north are free from ice from two to five months each year.

FROZEN WELLS, wells occurring in which ice is found throughout the year. In most wells of this kind the temperature is seldom above 32° F. The low temperature is due to the entrance of cold air into the interior of the earth in cold winter months. Kimball studied conditions in some abandoned iron mines at Westport, N. Y., and thus obtained a clue to the method of ice formation in wells and caves. It was formerly believed that the presence of ice was due to the fact that the well pierced a stratum of glacier drift in which ice still survived. A famous frozen well is that at Brandon, Vt., which long showed ice at 14 feet below the surface in summer time.

FRUCTIDOR, frük'tē-dōr, the 12th month of the French Republican Calendar. From the year I to VII it ran from 18 August to 16 September, and in the years VIII–XIII from 19 August to 17 September. It was followed by five supplementary days — the sansculottides — which completed the year. The 18th Fructidor, year V (4 Sept. 1797) is memorable for the *coup d'etat* by Barras, Le Révellière and Rewbell in expelling Barthélemy and Carnot. See FRENCH REVOLUTION.

FRUGONI, Carlo Innocenzio Maria, Italian poet: b. Genoa, 21 Nov. 1692; d. Parma, 20 Dec. 1768. He was originally destined for the Church and was even induced to take monastic vows. He gained a great reputation as an elegant writer of Latin and Italian prose and verse and from 1716 to 1724 he was professor of rhetoric successively at Brescia, Rome, Genoa, Bologna and Modena, where he attracted a great number of students. He finally settled down at Parma, where the Duke Antonio Farnese appointed him poet laureate. After the duke's death he returned to Genoa. Later he returned to Parma and devoted his remaining years to poetical composition. As a poet, Frugoni is regarded as one of the best of the Arcadian school. Consult his 'Opere poetiche' (10 vols., Parma 1779); 'Poesie' (15 vols., Lucca 1780); Carducci, 'Poeti erotici del sec XVIII' (Florence 1878); 'Lettere inedite,' edited by Bertoldi (Forli 1891); the biography in 'Fabroni Vitae' (Vol. I, 1778–1805); Torelli, 'Paesaggi e profili' (Florence 1861); Bertana, E., 'Intorno al Frugoni' in *Giornale storico della letteratura italiana* (Vol. XXIV, Torino 1883 et seq.).

FRUIN, Robert, Dutch historian: b. Rotterdam 1823; d. 1899. He received his education at Leyden and after 1860 was professor of the history of the Netherlands there. He edited Nijhoff's 'Bijdragen voor Vaderlandsche Geschiedenis' and contributed frequently to *De Gids* and other periodicals. He was the greatest authority on Dutch history in his time. He published 'Tien jaren uit den tachtigjarigen oorlog' (4th ed., 1889); 'Reply to Sir Bartle Frere' and 'Appeal to the People of England' (1881), dealing with the Transvaal question caused considerable comment at the time; 'Geschiedenis der staatsinstellingen in Nederland tot den val der republick' (1901); 'Verspreide Geschriften' (8 vols., 1900–03),

FRUIT, that part of a plant in which the seed or other reproductive element is perfected; in ordinary plants the matured ovary with its pericarp and other parts. Strictly speaking the term is confined to the true seed plants (spermatophytes). This botanical definition is largely extended in popular usage to include the sporangia of mosses and the sori of ferns and still more loosely and erroneously to any plant part useful to man.

Within the limits of the definition fruit structures show exceedingly wide variation. Typically the fruit is a mature ovary which contains seeds, but in some cases, as in the strawberry, the seeds are practically outside the «fruit,» being embedded in the pulp. Because of the difficulty of making a satisfactory and all-inclusive general classification on any other than that of evolutionary development the following sketch is given.

Dry Fruits.— Starting with those simplest flowers in which all the carpels (simple pistils or one of the elements of a compound pistil) are separate, we find the stigma and style usually withering back as no longer of service, and the ovary enlarging, as the fertilized ovules grow up into seeds. But in many simple flowers more ovules are produced than are fertilized, and generally also more fertilized than can be developed up to maturity; hence the reduction of the ovules is exceedingly common, as is simply exemplified in the horse chestnut.

A second principle of fruit-making is reached through keeping in mind the origin of the ovary from one or more carpellary leaves, of which the individual development has been so greatly checked that they remain closed upon the ovules, and frequently even coalesce with each other from the base upward, so forming a many-celled ovary. Yet the tendency to their individual expansion is not lost; in many monstrosities, and normally in a few types, such as the common mignonette, the carpellary leaves early begin to expand, so opening the ovary and exposing the seeds long before ripeness. Far more frequently, however, this final development of the carpellary leaves is delayed until the growth-processes of the seed and fruit have ended, and it is, therefore, accompanied, or even preceded, by their death; the separation often indicating the lines at once of leaf-margin and leaf-fall.

In the best-developed carpellary leaves, such as those of the more floral *Ranunculaceæ,* we naturally find the ovary opening along the line of its united ovule-bearing margins. This is what is termed a follicle.

Since, however, the ovules are on the united margins, the midrib tends to interpose little or no resistance to a tendency to split or tear along its fold. Such «dehiscence by both dorsal and ventral suture» gives us the legume or pod. Another type is the *siliqua* (or when shortened and broadened the *silicula*) of *Cruciferæ.* Here the placental edges of two united carpels develop a transverse septum which divides the fruit; and this is left when the lobes split away, as so familiarly in honesty.

Among united ovaries which readily split open at the united margins (*septicidal*) is that of gentian (q.v.), while the more familiar three-

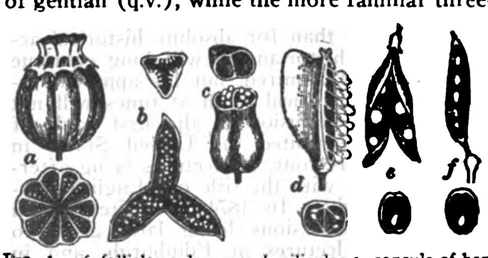


FIG. 1.—*f*, follicle; *e*, legume; *d*, silicula; *c*, capsule of henbane; *b*, of violet; *a*, of poppy.

celled ovary of violet, with its parietal placentation, gives a characteristic example of dehiscence along the midribs of the united carpels, so opening the loculi (*loculicidal*). In the five-celled capsule of the geranium (q.v.) the carpellary leaves separate not only at the sides but also at the base, so curling inwards and projecting the seed. Where, however, the placentæ remain more or less completely upon a

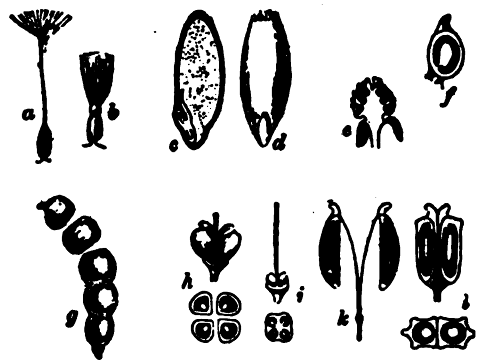


FIG. 2.—*e, f*, achenes of buttercup; *c, d*, caryopsis of oat; *a, b*, achenes with pappus; *g*, "lomentum"; *i, h*, nutlets and ovary of borage; *l, k*, umbelliferous type of schizocarp.

central column from which the valves are detached, the dehiscence is said to be septifragal.

In henbane (*Anagallis*), etc., the dehiscence is circular (*circumscissle*). Many-celled capsules are numerous in which the leaf-opening or dehiscence is greatly reduced from completeness; witness the valvular and porous dehiscence of the *Lychnis* and of the poppy respectively. Such cases clearly point us to those of carpels which do not open at all. Such indehiscent fruits, produced from carpels so persistently embryonic, are usually short, few or one-ovuled, and, for the most part, little specialized. Thus the follicle of the *Ranunculaceæ* of more specialized floral character becomes shortened into the one-seeded indehiscent *achene* of the anemone and the buttercup. In the achene of the grasses (which similarly represents the capsule of the ancestral lilies) the thin dry pericarp becomes inseparable from the seed-coat (hence the term caryopsis); in many trees (for example, hazel) it becomes hardened and thickened as a nut. In composites, too, the achene is practically a nutlet, although often (on account of its being inferior) superfluously termed a cypsela. Less extremely reduced representatives of the various multicellular ovaries to which such fruits correspond are afforded us by borages or mints in which the two-celled ovary of the primitive solanaceous type becomes, as in thorn-apple, etc., subsequently divided into four parts. In *Umbelliferæ* we have another characteristic form of schizocarp, as all such fruits are termed which split up without truly carpellary dehiscence, although the tendency to this can be seen still to have some influence. Here the separate portions (or mericarps), each resembling an achene or nut, are two in number, and when ripe swing off upon the ends of a forked carpophore.

Fleshy Fruits.— So far all our fruits have been dry; but a different physiological principle of fruit formation is necessary to comprehend those in which the pericarp is succulent. For, just as the effect of fertilization is seen in many animals to extend beyond the mere ovum to the parent organism, and also in many of the lowest plants, so it is in the case before us. Even in fruits which are dry on ripening we have seen that the ovaries or loculi, on which no demand is made for the growth of fertilized ovules, become reduced or disappear. Sometimes it may be merely the coats of the seed (as in the pomegranate) which undergo the complex histological and chemical changes which we sum up as those of succulence and ripening; at other times largely their placentas, as in gooseberry and currant. Yet, as in these, the innermost tissue of the ovary may become succulent as well. In the orange also the seeds are imbedded in the familiar succulent tissue of the enlarged loculi or "cells" of the endocarp; the grape, too, gives a characteristic example of soft endocarp. These may all be classed as berries or baccate fruits, for the distinction of the succulent product of an inferior ovary as a berry, from that of a superior one, as a uva or grape, need hardly be allowed to increase our nomenclature. A pepo is merely a berry in which the epicarp is thick and tough (for example, a melon, with which the orange and the pomegranate may be reckoned). Where the succulent change, instead of primarily affecting the deeper tissues of the fruit, and so producing a berry, leaves the endocarp hard, we have the drupaceous or stone-fruit. The endocarp here forms a more or less complete "stone" or "pit" around the kernel or seed, the difference from an ordinary nut being due to the succulence of an outer layer (mesocarp), with a more or less leathery outer skin, the epicarp. The plum, peach and cherry are the most obvious examples; but, since we may have many carpels thus transformed and more or less united as in the raspberry, we may have an aggregate fruit or syncarp of tiny drupes. The walnut and even the coconut are hence not true nuts. (See NUTS). The immature succulent mesocarp of the former is familiar in pickled walnuts, the ripe walnut we crack being merely the stony endocarp (which is exceptionally specialized in being set free by the bursting of the mesocarp on ripening). Coconut fibre is the fibro-vascular tissue of the mesocarp, the fruit being thus broadly comparable to a peach which has wizened while still young and stringy. But, as in the kindred grass, the coats of the ovule further unite to the endocarp.

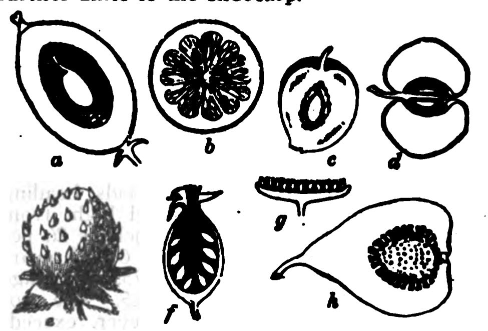


FIG. 3.—*a*, drupe; *b*, orange; *c*, a single drupelet of bramble; *d*, pome; *e*, strawberry; *f*, hip of rose; *g*, capitulum of Dorstenia; *h*, fig.

The numerous carpels of the strawberry, although, of course, corresponding to those of the allied raspberry, remain mere nuts; here, however, the subjacent portion of the floral axis or receptacle becomes succulent. In the perigynous and epigynous *Rosaceæ* the same change may take place; hence the rose-hip is a succulent axis, enclosing a multitude of nuts. The apple or "pome" is more akin to the drupe, since the carpels, here deeply sunk in the upgrown floral axis, develop a hard endocarp corresponding to the stone of a drupe.

Fertilization may even be followed by succulent or other thickening of the floral envelopes, or of the floral axis with subjacent bracts — the various cupules, as of acorn, beech, hazelnut, etc., being of this nature. Or we may have a spurious fruit developed at the expense of an entire inflorescence, as in the pineapple, Dorstenia and fig.

In the plantain and the banana the fruit is fleshy but when normally ripened it dehisces by the splitting of the pericarp into valves somewhat after the order of a bean pod. Another anomaly is the almond in which the construction is precisely the same as in the peach except that in the former the pericarp is fibrous, in the latter fleshy.

Chemical Composition of Fruits.— Our knowledge of the chemistry of fruit may be dated from the analyses of Fresenius (1857). But because of the innumerable varieties of almost every cultivated fruit, the effects of different soils and climates upon these, and still more of the fluctuation due to better or worse seasons, the results of any one chemical analysis would tend to convey an idea of undue precision. Thus — for example, while the ratio of sugar to free acid in certain grapes of an ordinary wine-year was found to be 16 to 1, in a very bad year it sank to 12, and in a very good year rose to 24. Hence a broad outline may be of more general use than the statistics of any one analysis.

The percentage of water may be taken as varying from 78 to 80 in the grape and cherry, as from 82 to 85 in plums, peaches, apples and pears, as 82 to 87 in brambles, currants, etc., and as much as 95 in the watermelon. The proportion of insoluble residue — skin and cellulose, stone and seed — obviously also varies greatly with succulence and ripeness, but may be taken, one fruit with another, at not less than from 4 to 6 per cent. Unripe fruits may contain a notable proportion of starch, but this is fermented on ripening into glucose and other sugars, fruit-sugar, grape-sugar, cane-sugar or (in *Sorbus*) sorbin. The only fruits which retain starch in important quantity are those of the banana, breadfruit-tree and baobab; hence the exceptional nutritive value of these. The olive alone yields a notable proportion of oil. The proportion of sugars varies exceedingly, dates, dry figs (48 per cent) and raisins (56 per cent), again very important foods, heading the list. Grapes, of course, stand high, from 12 to 18, indeed sometimes as much as 26 per cent, cherries from 8 to 13, apples 6 to 8, pears 7 to 8, plums 6, red currants 4.75, greengage plum 3.5, peach and apricot only 1.5. The proportion of pectin bodies is, however, exceedingly notable, especially in fruits such as the three last named. In unripe fruits (as also in roots) we find pectose, a body apparently related to cellulose, but easily transmuted by a natural ferment or by boiling with dilute acid into pectin, $C_4H_6O_4$, and its allies. These are all more or less soluble in water, with which they readily form a jelly (whence the peculiar consistency of our fruit-preserves). The proportion of soluble pectin and gum varies considerably and is of great importance to the blandness and agreeableness of fruit, the harder and more common apples having considerably less than 3 per cent and the best reinetts nearly 8. The red currant, indeed, like berries in general, has exceedingly little (0.25 per cent); while the apricot has as much as 9, the greengage plum 12 and the peach 16 — a circumstance which explains the peculiarly melting quality of these fruits, especially the last-named. The free acid also varies greatly, from 2.4 per cent in the red currant, 1.4 in the raspberry, and nearly as much in the sourest cherries, to 0.5 in sweet cherries and a minimum of 0.1 or less in the sweetest pears. That of apples and of grapes, of course, varies greatly, but both may generally be taken at from 0.75 to 1, while the apricot and peach stand at 0.3 or 0.4. The acid is primarily malic, but citric, acetic, oxalic, tannic and others may also be present.

The quantity of albuminoids is of course small, in fact, inadequate to render most fruits staple food. Yet it is by no means inappreciable, ranging from nearly .5 per cent in the majority of fruits to .7 or .8 in the grape (2.7 in raisins), and above 1 in the melon and the tomato. Hence to acquire albuminoids equal to those of one egg we must eat 1½ pounds of grapes, 2 pounds strawberries, 2½ pounds apples or 4 pounds pears. To replace 1 pound starch = 5½ pounds potatoes, we need 5.4 pounds grapes, 6.7 of cherries or apples, or 12.3 of strawberries.

The quality of fruits depends largely upon the proportion of sugar, gum and pectin to free acid, largely also upon the proportion of soluble to insoluble matters, but in very great measure also upon the aroma. This quality is due to the presence of characteristic ethers, often accompanied by essential oils, although not of course in ponderable percentage. Cultivation and selection operate strongly on all three factors.

Keeping of Fruit.— Many of the finest fruits undergo very speedy decomposition, which, as distinguished from the intrinsic processes of ripening, is due to the attacks of bacteria, molds or yeasts; so the problem of their preservation is therefore primarily one of preventing these. In damp and stagnant air, especially with considerable or frequent changes of temperature, these fungous pests multiply with special readiness; hence a fruit-room must be cool and shady, yet dry and airy, and the fruit carefully gathered rather before full ripeness, handled so as to avoid in any way bruising or tearing the skin, and laid out and occasionally looked over so that rottenness in one may not affect the rest. Under these conditions apples especially may be kept for many months; indeed many varieties of fruit — for example, winter-pears — require these conditions for satisfactory ripening. On antiseptic principles we see how it is that the dense-skinned and wax-coated grape can be so largely imported in sawdust, or how unripe gooseberries and even very perishable pears can be kept for months similarly packed in well-sealed jars in a cool place. The process of preserving with sugar in jars promptly covered up is similarly an antiseptic one; but in the systematic application of antiseptic princples we may still look for considerable progress in the preservation and transport of fresh fruit upon a large scale. The method of drying fruit has also been in use from remote times, especially with dates, figs and raisins. (See CIDER; FRUIT GROWING; FRUIT INDUSTRY; FRUITS, COLD STORAGE OF; GARDEN; and articles on the various fruits, as APPLE, CHERRY, PEACH, etc.). Consult works on fruit-culture by Bailey, Burbidge, Cheal, Downing, Du Breuil, Fish, Fuller, Hogg, Roe, Thomson, Wood, Paddock and Whipple, Sears, Barry, Warder, Thomas, Beach, Hedrick, Kains, Hume, Coit, Waugh, Wilkinson, Husman, Budd and Hansen, Card, Wickson, Webb, White, Popenoe, Munson, Chorlton, Fletcher, Maynard, Green and Meech.

M. G. KAINS.

FRUIT-BATS, the bats of the family *Pteropodidæ,* called also fox-bats or flying-foxes, because of their fox-like heads and faces. They compose one of the two grand subdivisions of bats, the *Megachiroptera* (see BAT), confined to the tropical parts of the Old World. These are the largest of all bats, and differ from the other bats in that they are entirely frugivorous. There are several genera, the most important being the genus *Pteropus.* The best-known species is the Indian fox-bat (*P. medius*), common in India, Ceylon and neighboring islands. As evening falls these bats fly out of the branches, where they have hung, like great black fruits, all day, and start on their nocturnal depredations, which they continue until dawn, when they return to their homes,— thousands sometimes forming a single colony, wrangling and jostling one another for the most desirable places on the limbs. Once settled they hang, head down, until day is over. They are so numerous and so destructive to crops in certain localities that they are hunted vigorously; but even when they are shot by thousands, the numbers do not seem to be materially decreased. There are certain species that sometimes feed on flowers as well as fruit; but this is not generally the case. The Indian fruit-bat, Lyddeker says, will greedily drink palm-juice from the pots hung on the trees to collect it, and at times, individuals have been found at the foot of the trees quite helpless from intoxication.

The spread of wing is from four to five feet in the Indian and Malay species; smaller than these are the ugly-faced *Harpyias,* so named because of the supposition that they were the «harpies» of the old mythology.

FRUIT-CROWS, the somewhat crow-like birds of that section of the South American family *Cotingidæ* called *Gymnoderinæ.* This section contains a number of most unusually ornamented birds, such as the bill-bird, and umbrella-bird, and most of them have bare spaces, or wattles, about the head. They are woodland birds whose habits are little known, but they feed mainly on seeds and berries, and make large nests in trees and bushes.

FRUIT-FLY, any of the flies of the family *Trypetidæ,* whose eggs are laid and maggots are bred in fruit, for example, the apple-maggot (q.v., under APPLE), or in plant stems. The Mexican orange-worm (see ORANGE INSECT-PESTS) is another well-known species, while the galls so frequently observable upon the golden-rod are the work of a third (*Trypeta solidaginis*). The maggots remain within the fruit or gall during the winter, then, if not already thrown down, creep out, drop to the ground and transform into pupa and imago. They vary in color from buff to brownish-black, and are frequently beautifully banded or spotted. See also POMACE-FLY.

FRUIT GROWING. Fruit growing is the art and practice of producing fruits for human consumption. Fruit growing is also highly developed as a profession; followed by many experts, teachers and investigators. In recent years there has been a tendency to develop the scientific aspects of fruit growing, and, although little progress has been made in the solution of fundamental laws, much knowledge of real value to the professional and practical fruit grower has been accumulated. The term pomology is frequently applied to the classified knowledge of fruit growing, but the two terms are really synonymous. The fruit grower's conception of the term fruit is much more restricted than that of the botanist's. In this country it is generally confined to the product of trees, bushes and woody vines, such as the apple, currant and grape. Important exceptions are the fruits of such herbaceous perennials as the strawberry and pineapple. The products of annual plants, such as watermelons, cantaloups, tomatoes, etc., are classed as vegetables. It is common practice to classify the fruits of North America into four general groups: (1) Orchard fruits, including the temperate zone tree fruits such as the apple, peach, apricot, plum, cherry, etc.; (2) grapes, the only important vine fruit; (3) small fruits, including the raspberry, blackberry, currant, gooseberry, blueberry, cranberry and strawberry; and (4) citrus fruits, including the orange, lemon, grapefruit and allied forms. To provide for such fruits as the pineapple, fig, olive and other fruits grown in milder regions of the country, the awkward but comprehensive heading tropical and subtropical fruits other than citrus, is frequently used.

A survey of the cultivated fruits of North America reveals the fact that native fruits have been of minor importance in developing the great fruit industries of the country. Of the more or less important fruits, the following are of foreign origin: the commercial apples, the pear, peach, apricot, quince, cherry, European plum, Japanese plum, Japanese persimmon, European grape, currant, certain gooseberries and most of the strawberries, all of the citrus fruits, pineapple, olive, fig and date. The native fruits have contributed several plums, a few apples, the grapes of eastern North America, the blackberry, dewberry, raspberry, loganberry, many gooseberries, some of the strawberries, cranberry and blueberry. The improvement of fruits, especially tree fruits, by breeding methods is a slow process and rather uncertain in its results. Practically all of the improved native fruits listed above are of chance origin. Many of the foreign introductions have been so altered in the course of time by the influence of environment, selection, and, to a small extent, by breeding, as to be now considered distinct American forms. Fruit growing in this country has been developed along amateur, local and commercial lines. There are varieties of fruit adapted for the home, the local market and the long distance market. The present-day improvement of varieties is largely with the commercial idea in view. Edible quality has been sacrificed to some extent; whereas appearance and shipping and keeping qualities have improved. Competition is becoming keener and the commercial fruit of the future must be of high quality in order to find a ready sale.

Commerce in fruits and fruit products during the early years of the 19th century was insignificant. It consisted in a small trade in fresh and dried apples, apple cider, apple brandy and vinegar, peach brandy, and in some localities, wine from native grapes. The increasing demand for cider led to the planting of many seedling apple orchards in the Northeast, and the culture of orchard and small fruits in general was gradually established in the vicinity of the larger towns. By the middle of the century the railroads began to penetrate the interior of the country, opening fertile regions adapted to fruit culture and broader commercial possibilities of fruit growing came to be more fully recognized. During the period from 1850 to about 1880 many large orchards, vineyards and small fruit plantations were established at long distance from their prospective markets, and plantings were increased in the vicinity of the large markets. The knowledge of fruit transportation and storage was limited. Nearby fruits frequently glutted the markets during the few days or weeks in which they were harvested and long-distance fruits could not reach these markets when local fruit was scarce. Such was the condition existing about 1890, when mechanical cold storage plants were adapted to storing apples over long periods and the more perishable fruits over temporary market gluts. Successful refrigerator car systems for conveying fruits long distances were developed about the same time. With the perfection of storage and transportation methods, fruit growing has become an important and highly specialized branch of North American agriculture. But few sections of the country are without some commercially important fruit industry.

Production.— The first attempt to obtain definite reports on the value of fruits produced in the United States was made by the 12th census in 1899. The total value of all classes of fruits produced in that year was $131,423,000. By 1909, the total value had increased to $218,000,000 which was equivalent to about one-third of the value of the wheat crop of 1909. The value of all deciduous tree fruits in 1909 amounted to $140,867,000; small fruits, $29,974,000; citrus fruits, $22,711,000; grapes, $22,027,000; subtropical and tropical fruits other than citrus, $1,995,000. Nearly four-fifths of the total value was contributed by apples, 38.3 per cent; peaches, 13.2 per cent; grapes, 10.1 per cent; strawberries, 8.2 per cent; and oranges, 8.1 per cent. Since 1909, the production of most fruits has gradually increased and competition has become keener. At the same time fruit values have conformed to the general upward trend in price of all commodities. As far as the commercial crop is concerned, the apple, the most important fruit grown in the United States, has been declining in production for the past 20 years. The bulk of the apple crop was formerly grown in the general farm orchards in the Northeast. Many of these orchards have passed the prime of life, produce inferior fruit and are dying. Thus far, the large crops they formerly bore have not been replaced by the many young orchards planted in other sections.

The principal orchard fruits of Canada are the apple, peach, plum, pear and cherry. The leading small fruits are the grape, strawberry, currant and gooseberry. As in the United States, the apple is the most important fruit grown. The production of all orchard fruits in Canada in 1910 amounted to 12,565,000 bushels of which 10,618,000 bushels were apples. Ontario is the leading province in the production of fruits, although apple orcharding has assumed some importance in Nova Scotia and British Columbia.

The geographical distribution of the important fruits is considered in articles dealing with these fruits (see APPLE, etc.). From the standpoint of commercial production the leading apple States are New York, Pennsylvania, Washington, Virginia, West Virginia, Missouri and Michigan; peaches, California, Georgia, Texas, New York, Alabama, Michigan and Pennsylvania; pears, California, New York and Michigan; plums, California, Oregon and Washington; cherries, New York, Washington, Wisconsin and Michigan; grapes, California, New York and Michigan; strawberries, Maryland, Delaware, Tennessee, Louisiana and Arkansas. Raspberries are widely grown throughout the northern half of the country. Limited commercial districts occur near large cities. New York and Michigan produce large quantities of raspberries for canning and drying. The loganberry, a blackberry-raspberry hybrid, originating in California, is now cultivated extensively in that State and Oregon for canning and drying. The principal citrus fruits grown in the United States are oranges, lemons and grapefruit. The cultivation of these fruits is largely confined to California and Florida. Limited quantities of oranges are grown in Arizona and in the Gulf Coast States. California produces about two-thirds of the oranges and practically all of the lemons. Florida produces about one-third of the oranges and most of the grapefruit. Of the smaller subtropical industries, pineapple growing is confined to Florida, and the production of dried figs and olives to California. It is practically impossible to secure complete and comparable statistics on the fruit industries of the country as a whole, but from data largely obtained from the United States Bureau of Markets, it is conservatively estimated that it required 200,000 cars to move all classes of fresh fruits in 1917. Nowhere in the United States are all branches of commercial fruit growing centered to such an intensive degree as in California. This great region has a multitude of local climates, much variety of soil and rainfall, and physical conditions which strongly differentiate it from the remainder of the United States. With one or two exceptions, such as the grapefruit and pineapple industries of Florida, every commercial fruit industry in the country as a whole has been duplicated in California and many industries, such as lemon, Smyrna fig, olive and European grape growing have been al-

FRUIT GROWING

1 Birdseye View of a Well-cultivated Peach Orchard

2 Strawberry Growing in Wisconsin

most localized there. If we except dried apples nearly all of the cured fruits are produced in California and about two-thirds of the canned fruits. In 1917, California shipped from the State 24,340 cars of fresh grapes, peaches, pears, plums, etc. The commercial citrus crop of California for the shipping season ended 1 Oct. 1917, was oranges, 46,447 carloads, and lemons, 7,914 carloads. The estimated production of dried fruits, including apples, apricots, figs, peaches, prunes, raisins and others was 341,100 tons, of which more than two-thirds were prunes and raisins. California packed over 7,000,000 cases of canned fruit in 1917. In recent years the citrus and pineapple industries in Porto Rico and the pineapple industry in Hawaii have developed rapidly. About $6,000,000 worth of canned pineapples were shipped from Hawaii to the United States in 1915. The same year Porto Rico shipped about $3,000,000 worth of pineapples, grapefruit and oranges to the United States.

Export Trade.— During the past 15 or 20 years the United States has developed a big business in fruits with other countries. The exports consist of dried and canned fruits as well as fresh apples, oranges and pears. Exports of all fruits during the year ended 30 June 1900, amounted to $11,486,000. By the year ended 30 June 1914, fruit exports had increased in value to $31,030,000 and for the year ended 30 June 1917, to $37,652,000. The fruit imports for the same years are: 1900, $16,284,000; 1914, $33,638,000; 1917, $25,315,000. Bananas and lemons comprise more than half of the imports. The balance is made up of dried currants, grapes, raisins, figs, olives, pineapples, dates and other fruits. The war has created an active demand for exports of canned and dried fruits, but has curtailed imports of fruits of all kinds. The principal fruit exported from Canada is apples. An average of 1,242,000 barrels annually, valued at $3,626,000, was exported during the five years ended 31 March 1913. During this same period, Canada's annual fruit imports amounted in value to about $10,000,000.

Cultural Practices.— In the early days when fruit had no financial standing as a crop, the farm orchard or plantation was given indifferent care at the best. With the rise of commercial fruit growing this condition has rapidly changed. Cultural practices, specially adapted to large area planting, have been evolved. The extent to which these practices are employed in certain regions varies largely with the relative importance of fruit growing and other agricultural pursuits. Men who make fruit growing their main pursuit have been quick to adopt methods that enhance the prospects of a good annual crop. Modern practice calls for just as thorough a preparation of the soil before planting fruit trees as is given other farm crops. The soil should be stirred deeper, because the main roots are to establish themselves some distance below the surface. The best planting conditions are secured when the land is occupied by a fertilized and cultivated crop the year before the trees are planted. As a rule solid plantings of the same kind of fruit are more easily managed and will be more successful than mixed plantings of different fruits. On the other hand it is safer to include several commercial varieties of the same fruit in a planting because most varieties yield better when pollinated by another variety than when self-pollinated. In most situations fruits will thrive best when tilled or cultivated than when grown in sod. There is rarely enough moisture for both trees and grass. For this reason grain crops should not be grown between the rows. In order to reduce the cost of developing an orchard, cultivated crops may be grown for a few years, provided they are well fertilized and neither the crop nor the necessary preparation of the land interferes with the ever-extending tree roots. Frequent light tillage from early spring until midseason conserves moisture and assists in making plant food available to the tree roots. Tillage prolonged throughout the whole season, however, will eventually destroy the physical texture of the soil, promote soil erosion and puddling; and may stimulate the trees into a late immature growth subject to winterkilling. To prevent this, the orchard is seeded down with a cover crop such as rye or clover as soon as the trees have ceased making rapid growth. This crop is turned under in the spring, thus supplying humus for loosening the soil. If clover or other legumes are used as cover crops, an important amount of nitrogen is added to the soil. In the West much of the fruit is grown under irrigation, and the tendency has been to till the land throughout the season in order to conserve as much moisture as possible. The detrimental effect of continued clean tillage on soil texture is so evident that the use of cover crops in that region is becoming more common. It is generally recognized that fruit crops exhaust the fertility of the land in much the same manner as other farm crops, and the best fruit growers use fertilizers in some form or other. Soils vary so much even over short distances that the fertilizer question must largely be solved by the individual grower. In lieu of more specific knowledge on the subject, the fertilizer practice of successful growers in any section is apt to give the best results.

Spraying fruits for the control of insects and diseases is a well established and generally necessary practice. Spraying equipment has been perfected for large and for small plantations and spraying formulas have been worked out to meet the needs of different sections of the country. Sprays are usually applied in liquid form. Quite recently some progress has been made in the perfection of dusting machines for orchard use. The fumigation of young fruit trees in nursery establishments for the control of scale insects is a common practice and is required by law in many sections. (See INSECTICIDES; FUNGICIDES). Most fruit growers practice pruning to some extent. The best practice calls for a light annual pruning rather than intermittent heavy pruning. Pruning is apt to be neglected over too long intervals because it requires more knowledge and experience than other orchard work and skilled labor is not always available. The subject is discussed under Pruning (q.v.). Fruit trees often set more fruit than can be matured to marketable size. An excessive crop usually means small and often poorly colored fruit. The overloading breaks down the limbs of the tree; thus favoring the development of disease, and, at the same time, reducing the chance for a good crop the succeeding year. These conditions can be corrected by thinning the fruit. Thinning is an established practice with peaches and other summer fruits. Such fruits show remarkable increase in size from thinning. When a market for high quality fruit is assured, it is often profitable to remove as much as two-thirds of the immature fruit. There is an increasing demand for high quality apples, and thinning is more common in the best commercial districts. Varieties that naturally grow large should not be thinned beyond the point of reducing excessive strain on the tree. In the citrus regions the fruits require several pickings and each of these pickings might be called a thinning operation. The usual time to thin is just after the so-called June drop, when the tree sheds much fruit that failed to pollinate and when growth is still active. The amount to thin varies with the kind of fruit and the variety. Rarely will it pay to thin unless the remaining fruits are well sprayed.

Very frequently young trees are attacked by rabbits, mice, woodchucks and the like and serious damage is done. If the trees are still vigorous and the wounds are not too extensive, the trees may be saved by bridge grafting. When young trees are set in districts where such rodents are numerous, it is a good plan to use some form of a tree protector. These protectors may be of wood veneer, wire netting, lath or tar paper. They should be set into the earth several inches and surround the trunk up to the base of the lower limbs. In milder sections of the South and West, heavy spring frosts sometimes do much damage to the young fruit buds and newly set fruits. In the West particularly, many large commercial orchards are equipped with fuel pots for burning crude oil, distillate and coal, while others use wood. Orchard heating devices are quite common in the citrus regions. The present orchard heating devices are far from perfect and much more must be learned about the range of effectiveness and the limitations of orchard heating before the practice becomes general. They have been more successful when employed over a large contiguous area and with fruits bringing high prices than when employed by individual growers and with fruits bringing low prices.

Generally speaking, cultural practices are more highly developed in those regions that are devoted almost entirely to fruit growing and are dependent on long distance markets. The same is true of methods of picking, grading, packing and marketing fruits. It has been thoroughly demonstrated that careful handling in preparing the fruit for market means a minimum of decay or deterioration in transit, on the market, or in storage. Also the prompt precooling of carefully handled fruits has a marked influence on their carrying and holding qualities. Competition in the fruit trade is keen; hence, fruit that is well grown and given every attention in getting it to the market in good shape must be put up in an attractive manner in order to secure remmunerative prices. The present practice is to put up choice fruits in packages small enough to induce customers to buy by the package. This has resulted in so many different sized packages that it has made marketing more or less difficult, both for the dealer and the consumer. Recent legislation by the Federal government and by several of the States provides for standard sizes in fruit packages, whether they be large or small. Fruit grades, especially for apples; have also been established in several States.

The country-wide development of fruit growing has been favored by climate, soil and economic conditions. This growth has also been fostered by governmental, State and provincial agencies. The Federal and Dominion Departments of Agriculture and the various State and provincial agricultural colleges and experiment stations have contributed largely to the knowledge underlying the principles of commercial fruit growing. Cultivated fruits have been introduced from foreign countries, varieties have been tested, and cultural problems worked out in experimental orchards. Successful practice has been studied in the field with the view of determining the reason for success and many investigations are conducted in commercial fruit districts in order that the results may have an immediate practical value. Until very recently, the cultural phases of fruit growing received most attention. The ever increasing competition between different sections of the country has caused the governmental agencies to take up many marketing problems, both technical and economic in nature. Many improved practices have resulted from studies in the handling, precooling, transportation and storage of fruits. The question of distribution is now receiving attention. The Bureau of Markets of the United States Department of Agriculture has an inspection service in most of the large markets for the purpose of investigating and certifying to shippers the condition and soundness of fruits when received at the market. Information on daily carload movements of fruit is now available to fruit growers in the commercial areas. See also the articles on the particular fruits.

Bibliography.— The Department of Agriculture of the United States and of Canada as well as the State agricultural colleges and experiment stations have issued numerous bulletins and reports on the practical, technical and scientific phases of fruit growing. The agricultural and general press and private writers have also contributed largely to the literature of fruit growing. Some of the general works on the subject are Bailey, L. H., 'The New Standard Cyclopedia of Horticulture' (6 vols., New York 1914-17); id., 'Principles of Fruit Growing' (New York 1915); id., 'The Pruning Manual' (New York 1916); Sears, F. C., 'Productive Orcharding' (Philadelphia 1914); Moore, S. W., 'Practical Orcharding on Rough Lands' (Akron, Ohio 1911); Paddock and Whipple, 'Fruit Growing in the Arid Regions' (New York 1910); Wickson, E. J., 'The California Fruits and How to Grow Them' (San Francisco 1914); Coit, J. E., 'Citrus Fruits' (New York 1915); Card, F. W., 'Bush Fruits' (New York 1917); Brown, B. S., 'Modern Fruit Marketing' (New York 1916).

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FRUIT INDUSTRY. While fruits have been grown since earliest times to supply homes and comparatively local needs, fruit growing

FRUITS READY

Y FOR PLUCKING

has become worthy of the status of an industry only within the past century. Prior to this period commerce in fruits was limited almost wholly to dried fruits such as dates, figs, prunes, raisins and nuts, though oranges, lemons, coconuts, apples and a few other fresh fruits were successfully transported short distances and sold during the few weeks or months that they could be kept by the crude storage methods of those days. The main limiting factors of the fruit industry then were slow transportation, defective storage methods and the generally sufficient local supplies to meet the restricted demand.

These conditions applied not alone to America, where they, however, were most strikingly evident, but to the whole world. Not until sailing vessels gave place to steam and canals to railways did progress begin to be rapid. With the development of these improved methods of transportation came countless other improvements, not alone in speed but in storage and marketing, canning and drying. By their reaction these factors have stimulated production until the fruit industry now plays a highly important rôle in the world's commerce. Whereas in the United States half a century ago the area devoted to fruits and the value of the fruit products were small fractions of the total area and value of all crops grown, the increase has been such that in 1909 when the last census was taken they were about 2 and 4 per cent respectively of the gross totals and values of all farm crops. Development from that time forward continued to be rapid until the Great War placed a temporary check upon certain phases of planting, transportation and manufacture. Lest the percentages mentioned above should appear insignificant let it be noted that the area devoted to fruit growing in 1909 was upward of 10,000,000 acres and the value of the fresh fruits at point of production more than $215,000,000. Since that date millions of trees not then in bearing have added their quotas to the output, so both percentage and total value have been augmented.

Perhaps the most far-reaching effects of the improved transportation and storage have been the education of public taste and the consequent demand for fresh fruits in regions remote from points of production. Refrigerator cars, steamships and cold-storage warehouses have made it possible for growers a thousand to several thousand miles from market to grow fruits at living and often highly profitable prices, at the same time lengthening the season during which consumers may enjoy fruit. Steamship lines whose main business is the transportation of tropical fruits have been established between Mexican, Central American, West Indian and Mediterranean ports and those in the North, so the northern regions now secure abundance of these products. Similarly trainloads of fruits are shipped from the Pacific Coast States in refrigerator cars and forwarded on almost express schedule east of the Rocky Mountains. Still more striking is the instance of the strawberry which instead of being confined to the local period of production — about three weeks — may now be obtained in northern markets during six months, the earliest coming from Florida and Louisiana during January, the latest from northern New York during June. This period has recently been still further extended by the so-called "ever bearing" varieties which continue the local season in the North from July until October and even November. These varieties, however, have as yet scarcely attained commercial importance.

Again, thanks to the improved methods mentioned, the variety of products obtainable at any given season in the markets not only of the large cities but the small towns is no longer confined to the species locally produced before these methods came into play, but has been increased by countless kinds from distant points of production. It is nowadays no unusual thing to be able to choose among 25 or more fresh fruits offered for sale at one time in such large city markets as New York, Boston, Chicago or San Francisco. Dried, canned and preserved fruits and manufactured fruit products such as wine, cider, vinegar and juices have during the period in question become staple commercial commodities obtainable the year around. The net effect of these improved methods is such that the number of cultivated and even of the important wild fruits suited to human consumption not found in the world's markets in either the fresh or the manufactured state is steadily decreasing.

Among leading fruit producing countries of the world and the principal products the following may be taken as typical examples suggestive of the industry as a whole. The American tropics export enormous quantities of bananas, pineapples and coconuts to northern markets. The United States, Canada and Australia ship apples to Europe, where commercial plantings are too small to supply continental demand. Reciprocal shipments from Europe to America consist largely of dried fruits, such as figs, prunes, raisins, currants and oranges, lemons and grapes. The quantities of all these fruits imported are lessening as American growers gain knowledge of how to grow equally good supplies. In each continent there is similar reciprocal shipment, the tropical and subtropical fruits moving north and the temperate climate ones going south but to a less extent. In North America the movement of fruit is far more extensive than in any other continent. In addition to southern shipments northward and western ones eastward, there is a considerable movement from east to west and from north to south. California and Florida annually ship trainloads of oranges, lemons and grape fruit beyond their borders. The former also exports fresh, dried and canned plums, cherries, peaches, pears, grapes, apricots; the latter sends pineapples, strawberries, peaches and to a small extent subtropical fruits.

The opening years of the present century have seen a still more striking development of the fruit industry in the enormous and increasing plantations of cool climate fruits, notably apples, pears, plums and cherries in Oregon, Washington, Idaho and other northwestern States. These are being grown not merely for home consumption in those and adjacent districts, nor even for shipment to Atlantic and other eastern States, but to Europe and South America. Besides the factors of refrigerator car transportation and cold-storage warehousing the recently opened Panama Canal bids fair to have a marked influence; for by its means the cost of shipment to Europe may be lessened and markets on the eastern coast of South America reached more expeditiously and less expensively than when the route includes rail transportation from the orchards to Atlantic ports, transfer to steamer there, ocean voyage to Liverpool or other British port, a second transfer to other steamers and a second voyage to or through the tropics to some port in eastern South America. Developments were being made toward the more direct route suggested when brought to a halt by the Great War.

The principles upon which the fruit industry of these Northwestern States has been able to develop in spite of competition from older and more firmly established Eastern fruit-producing regions are so thoroughly sound in themselves that they are slowly but steadily revolutionizing the fruit business everywhere. First, by means of cultural methods adapted to the region the fruit is given a finish not usually found in the older producing districts where nearness to market permits the sale of all grades of fruit. Second, careful sizing and grading are insisted upon by organizations of growers who realize that in order to make sales at all and the more important repeat sales they must maintain a higher standard of product. Third, the adoption and perfection of the box rather than some other package in which to ship and sell fruit. Fourth, uniformity and attractiveness of packing in these boxes. Results have justified the care exercised; for buyers and final consumers have been taught through experience with these goods that they do not need to open the packages but can depend upon the statements printed on the labels as to the contents. Herein perhaps lies the answer to the question as to what factor is now destined to exercise most importance in the further development of the fruit industry.

As to what fruits are of relatively most economic importance, doubtless among fruits consumed in the fresh state the orange leads since it is grown in the warm parts of all the continents though it enters important commercial channels mainly from southern Europe, the West Indies and the semi-tropical parts of the United States. It is also of importance as a source of cider, juice, marmalade and peel. Probably the apple ranks next, with the mild parts of North America and Australasia in the lead. It finds the widest use of all fruits — fresh, evaporated, butter, marmalade, jelly, cider, vinegar, wine, champagne, brandy and countless culinary dishes. Then follows the grape which is grown on all continents from the tropics almost to the limits of agricultural endeavor, for consumption in the fresh state and as raisins, «currants,» wine, juice, vinegar, jelly and argols (a by-product of wine making used as a source of baking powder). The plum used fresh, preserved and as prunes comes next. Olives as a source of oil and a condiment; lemons candied and raw; bananas fresh and as flour; peaches fresh, canned and dried; pears, dates, figs, strawberries, pineapples and cherries take commercial rank in about the order named.

Judged by commercial standards, quantity and variety of products, prompt adaptation of scientific principles and business sagacity to fruit production and disposal, the United States and adjacent Canada rank first among the countries of the world. This is particularly evident in the development of many branches of the industry. While fruit growing in America has scarcely deserved the title «industry» for as long as a century, several branches have been developed from the original wild species in scarcely more than half that time. One notable instance is the American grape, the leading variety of which, the Concord, first bore fruit in 1849, yet in the 70 years since then it has extended to practically every State and province. It is now grown upon tens of thousands of acres and profitably employs thousands of people. Its latest development, the manufacture of juice, is a purely 20th century industry which now involves several million dollars in buildings and equipment. The European strawberry, like the European grape, having failed in America, native species were developed so that now trainloads of berries daily go to market from individual shipping stations. Similar remarks, though in less degrees, are true also of raspberries, blackberries and cranberries. All of these have been developed from strictly American species and all since the middle of the last century.

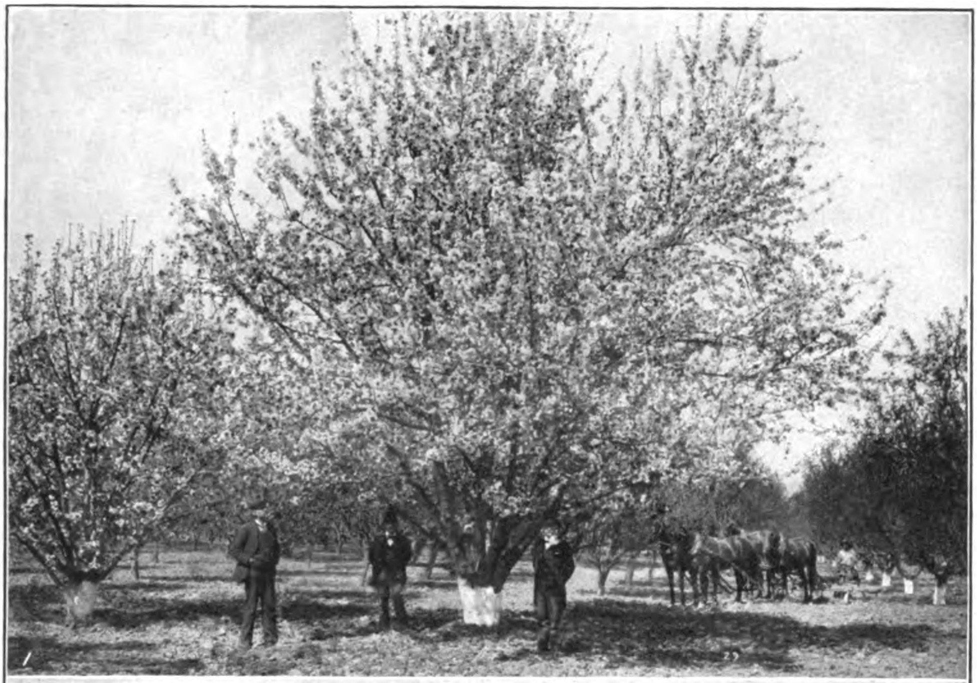
The fruit industry and its sponsors have not alone profited by its development. With it have been developed many other lines of business which directly or indirectly depend upon fruit growing. A partial list includes the following: The nursery business, the manufacture of pruning tools, spraying apparatus, insecticides, fungicides, fertilizers, tillage implements (many of these specially designed for work in fruit plantations), harvesting equipment, grading machinery, marketing receptacles and many others. Then there is the reflex action of fruit growing upon the development of cold-storage, refrigerator car building, railway freight traffic and commercial practices. Added to these are the subsidiary industries such as canning, evaporating, wine, juice and vinegar making, each in itself involving enormous capital and employing great numbers of workmen.

M. G. KAINS.

FRUIT-PIGEONS, a group (*Trevoninæ*) of pigeons of very brilliant and often curious plumage, and frequently of large size, which are scattered from India to the South Sea Islands. They spend their lives in the tops of the forest trees and feed wholly upon fruits, which are swallowed whole. There are about 180 species, chiefly of the genera *Carpophaga* and *Ptilopus*.

FRUITS, Cold-Storage of, the preservation of fruits, by keeping them in a refrigerator or ice-box of such a temperature as will neither freeze them nor permit the process of ripening to advance. The problem of cold-storage has at length been solved by experiments successfully made by the government expert, W. H. Ragan of the Department of Agriculture, at Washington. It had been generally supposed that cold-storage fruit quickly rotted, on exposure to the ordinary atmosphere of the dwelling-house in summer or winter. It has, however, been discovered that when fruit is put up in a proper condition and kept subject to a proper temperature, it remains uninjured by storage for some time. Thirty-two degrees is considered suitable temperature for the cold-storage of fruit.

FRUIT GROWING



1 Napoleon Cherry Trees in California **2 A West Virginia Peach Orchard**

1 Dewberry Field in Maryland

2 Gathering Peaches in Georgia

Peaches of good color, yet still hard, if fresh from the tree, have been kept in cold-storage for four weeks and found at the conclusion of that period in fairly marketable condition. They have maintained this condition for at least four days. It is only when they are in bad condition, imperfect and poorly colored, that they spoil on exposure, after resting in cold-storage.

In order to obtain good results the temperature of a cold-storage warehouse should be kept uniform throughout. Freshly plucked fruit is alone suitable for storage, for a delay of a few days, even of a few hours, will result in serious loss. While pears must be gathered as soon as they reach their full size on the tree, apples may best be stored when well matured and highly colored, though still hard. The storing should be made in small packages, certainly of not over 50 pounds; this is especially the case with regard to quickly fermenting fruits, such as pears and peaches. The careful ventilation of the cases, barrels or boxes, which enclose the fruit, is absolutelv indispensable. Nothing is more likely to prolong the preservation of fruit in cold-storage than wrapping them individually. Double-wrappings are even better than single. The inner paper should be porous, like blank newspaper tissue, the outer may be paraffin paper.

FRUITS, Tropical. Many tropical fruits are well known in the colder zones. Some of them are even cultivated in subtropical climates, in northern greenhouses, or as annuals whereever summer-heat is sufficiently torrid; as, for instance, okra, tomatoes, melons, egg-plants, peppers and peanuts. Others, like the pomegranate, lime, orange and related citrus fruits, banana, pineapple, fig, date, coconut, alligator-pear, litchi, coffee- and cocoa-beans and various familiar nuts, as Brazilnuts, are imported in a fresh or dried condition. Cooled ships are arranged for their transportation, especially for that of the fast-ripening banana. But most of the soft fruits of the tropics either will not survive long journeys, or will not pay for the trouble.

They form, however, an important part of the food of the natives in the Equatorial Zone who raise them in tiny scattered orchards or in their dooryards, or pluck them from wild groves. Many of these fruits, like the coconut and tamarind, have been carried from port to port and have been cultivated and even naturalized in so many tropical countries that their place of origin is a matter of dispute. Some of them are used as vegetables as in the case of the familiar tomato, egg-plant and okra. In the Philippines sequidillas (*Psophocarpus tetragonolobus*) are the tender angular pods of a leguminous vine, which are boiled, having an asparagus-like flavor. The pear-shaped fruits of a cucurbitous vine which is trained on arbors and is white or green, rugged of rind and single-stoned, is known as the chayote, or cho-cho (*Sechium edule*), and is boiled, stuffed and baked like squash, which it much resembles in taste and consistency. Africa contributes the akee (*Blighia sapida*), a brilliant vermilion-hued fruit, within which are shining black seeds perched on cream-colored fleshy arils which are cooked, generally with salt fish, and have the appearance and taste of scrambled egg-yolks. If eaten before the fruit has opened of itself, however, Jamaicans claim, the akee is a swift and deadly poison. The heavy, round compound breadfruit (*Artocarpus incisa*), too, is baked, or boiled, or even dried and converted into flour. It is an utterly tasteless vegetable, and for this reason can be used as frequently as a potato. Its seeds are also boiled for food. The sweeping from the trees of this dooryard fruit is one of the tragic results of a West Indian hurricane, since it destroys thus one of the food staples of the peasantry, having been brought to them from the Asiatic Archipelago. Its close relative, the jack-fruit (*Artocarpus integrifolia*), is larger, and so heavy that it is borne on trunk and limbs of the trees instead of at the tips of the branches. Green bananas, or plantains (*Musa sp.*), are also served as a vegetable, often being sliced and fried, and having a pleasant subacid taste.

Among the most prized tropical fruits are the thick-skinned mangosteen (*Garcinia Mangostana*); the little, round, brown sapodillas (*Achras Sapota*), in the West Indies called naseberries, evidently a contraction of an earlier title "Nispera." They are cut into hemispheres, so that the soft interior, not unlike a baked pear in flavor, may be scooped out. The East Indian durian (*Durio Zibethinus*), whose oval fruit is defended by spines which have been said to flay a man's face if struck by the falling fruit, and by a very offensive odor, is a favorite dessert with those who can forget the smell of the otherwise delicious pulp.

Other pulpy fruits are the little fragrant rose-apple good for jellies and dessert (*Eugenia Jambos*); and its relative, the Malay apple (*Eugenia malaccensis*); fruits borne on small anonaceous trees, which include the sweetsop (*Anona squamosa*) that remotely resembles a young pine-cone when ripe having greenish polygonal knobs rising from the ivory-tinted rind. It is readily torn apart in the hands disclosing slender black seeds enveloped in sugary pulp. The soursop (*Anona muricata*) is a curious shapeless green bag armed with weak prickles, enclosing crowded carpels, the seeds immersed in envelopes much like cotton wadding to the tongue, but filled with juicy pulp. Rather musky and tart in flavor, it is a favorite cool dessert served as a custard with cream, or as a sherbet. The cherimoyer (*Anona Cherimolia*) and custard apple, the latter also known as bullock's heart from its shape and size (*Anona reticulata*), belong to the same family and are not dissimilar.

The papaw (*Anona triloba*) of the Southern States is another member of this family, but the papaw of the tropics (*Carica Papaya*) is a different affair. It rises above the garden patches like a palm, but is really a sort of tall herbaceous plant, very slender, with a tuft of huge cut leaves at the top, beneath which hang dozens of canteloupe-like fruits that when cut disclose a hollow centre lined with small, black mucilaginous seeds. Its juice is said to render meat tender, it is the source of a drug and is itself prescribed for digestive troubles.

Avocados, or alligator pears (*Persea gratissima*), were at one time called "Midshipman's butter," the smooth rich flesh having been spread on bread, but they are now more generally used as a salad — or dessert — fruit.

They grow on a rather large tree. The star apple (*Chrysophyllum Cainito*) is also a large tree which changes color continually as the wind turns up either the green upper-surfaces or the satiny brown under-surfaces of the foliage. «You are just as deceitful as a star apple» is a West Indian comment supplemented by another, «he sticks like a star apple,» for this fruit, a little larger than an orange, smooth, purplish or green in color, hangs persistently on its long stem. When cut transversely, the severed tops of the seeds radiating from the centre form a star embedded in gelatinous flesh stained with color from the rind, from which gummy juices exude and cling to spoon and lips. The mammee apple (*Mammea Americana*) and the Otaheite apple (*Spondias dulcis*) are also grown for their fruit. Passion-flowers yield fruit rather like that of the «Maypop» of our Southern States. One of them, the golden apple (*Passiflora laurifolia*), clambers over shade trees and drops its oval fruits on the ground. The contents are mucilaginous and seedy and are sucked out. Others are the grenadilla used in ices and the sweet-cup (*P. quadrangularis, P. maliformis*).

It is said that a species of jujube was the «Lotus» of ancient history, but the small fruits of Jujube Zizyphus do not seem surpassingly tempting; they are generally dried and used as a refreshing acid dessert in winter, and formerly were an ingredient in «jujube paste.» A famous Mexican fruit is the «tuña,» produced by several varieties of cactus, especially by Opuntia Ficus-Indica and O. Tuña. An Opuntia plant appears on the coat-of-arms of Mexico. It is also called prickly pear from its shape and armament, or Indian fig on account of the many small seeds embedded in its somewhat acid pulp; it has been carried to the Mediterranean shores, thriving on their arid, hot sands and has become a veritable pest in Queensland. Some of the «tuñas» are prickly, and an old traveler says that Spanish dons played a trick on newcomers by rubbing several «tuñas» in a napkin, thus fastening the infinitesimal spines in the fabric «wherewith a man wiping his mouth to drink, those little prickles stick in his lips so that they seem to sew them up together, and make him for a while falter in his speech.» The cashew (*Anacardium occidentale*) has peculiar kidney-shaped fruits or nuts poised on the tips of swollen, pear-shaped, fleshy stalks that, although astringent, are eaten as «cashew apples» and furnish a wine. The shelled nuts are usually roasted and eaten with salt, and are said to be better than almonds. The tropical almond (*Terminalia Catappa*), a handsome street tree, also bears edible almond-like nuts. Tamarinds are the fruit of a huge leguminous timber-tree (*Tamarindus indica*), which is covered by the buffy pods, fragile-shelled, very like ripe bean-pods, but filled with a dark-brown acid pulp which is utilized for cooling drinks and also for tart preserves. There are also small fruits known as «plums» that are used for preserves, and the small, tough, puckery, pink-hearted yellow guava (*Psidium guava*) is famous for the sweet paste and jelly made from it.

Mangoes (*Mangifera indica*), however, are among the most valuable of tropical fruits. Unripe they are preserved and pickled and when ripe are eaten from the hand. The mango is so important a food that Jamaican bakers do not expect to sell as much bread as usual when this fruit is ripe. There are many which are cultivated in the tropical belt and have become naturalized therein; the inferior sorts are fibrous and have a turpentiny taste, but the better kinds are softer and more luscious. At the best the mango requires skill in manipulation; the tough fibres surrounding the husk of the seed radiating through the flesh. Golden loquats (*Eriobotrya Japonica*) and the fruits of many palms are among the minor fruits of tropical regions. Oily Sesame seeds (*Sesamuna orientale*) are cultivated for food and oil.

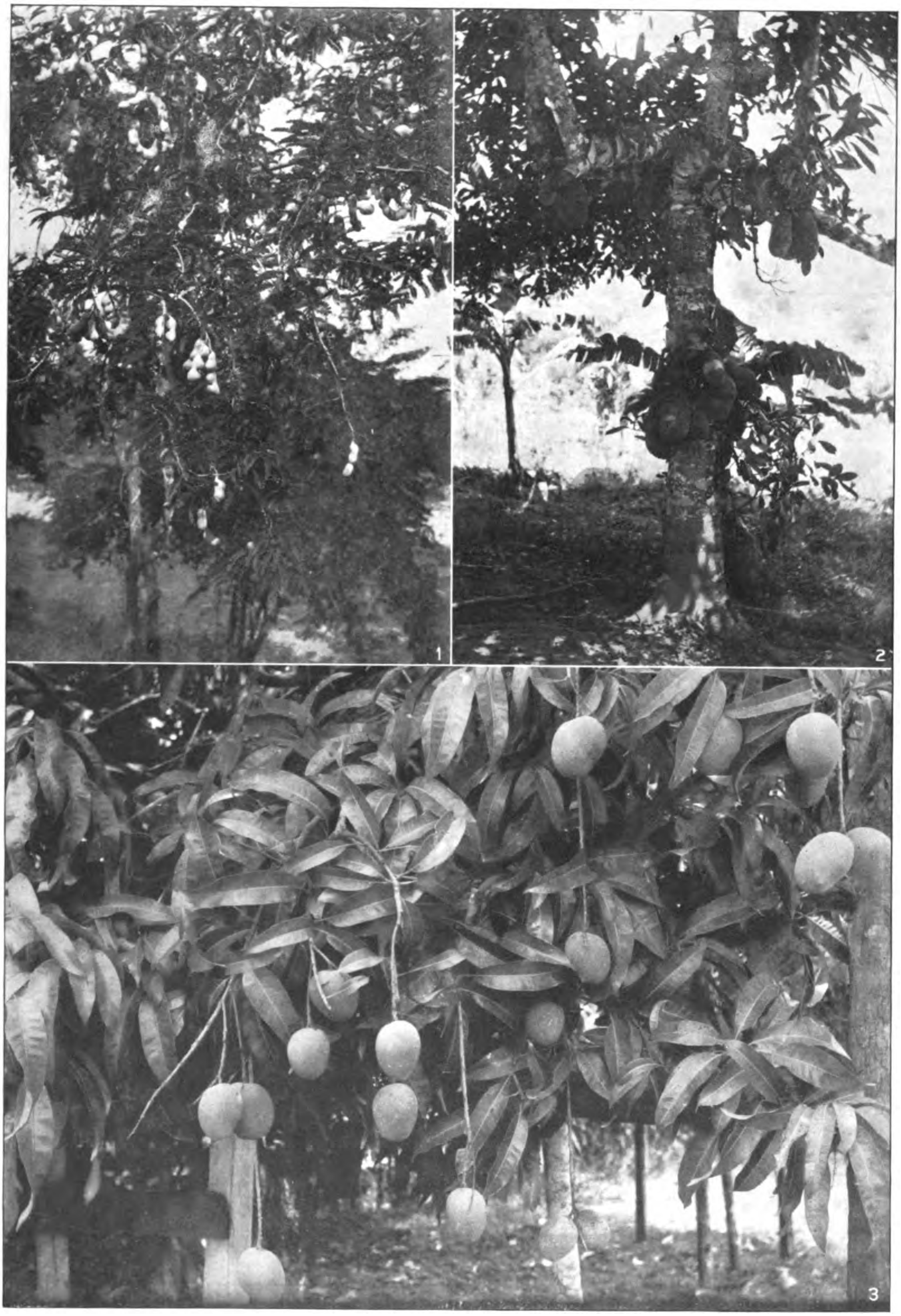
Although not eaten directly, the pencil-shaped pods of an orchid (*Vanilla officinalis*) are cured for flavoring purposes, becoming the vanilla of commerce. They are the fruits of a cultivated vine which creeps up tree-trunks. Annatto, or achiote seeds, are also gathered from the little tree, Bixa orellana, for the sake of their arils, which yield an orange-red dye applied to dairy products, and formerly used as a skin paint by South American aborigines. The dried fruit of pimento (*Pimenta officinalis*) becomes the allspice of commerce, while the seed and arils of Myristica fragrans are known as nutmeg and mace. Consult Candolle, Alphonse de, 'Origin of Cultivated Plants' (New York 1902); Cook, O. F., and Collins, G. N., 'Economic Plants of Porto Rico' (Contribution United States National Herbarium, Vol. VIII, pt. 2, Washington 1903); Philippine Commission, 'Report' (Part 3, United States War Department, Washington 1907).

HELEN INGERSOLL.

FRUITS OF CULTURE, The (PLODUI PROSIVYESHCHÉNIYA). Count Tolstoi recognized in the drama an immense power for driving home his ethical teachings. His second play, 'The Fruits of Culture' (or 'The Fruits of Enlightenment,' 1889), is a satirical comedy with a triple purpose — to show up the absurdity of superstition, whether manifested by people of culture or by simple-minded peasants; to discredit the medical profession; and to contrast the frivolity of the so-called educated and wealthy classes with the simplicity and dignity of the sons of the soil. Spiritualism is the principal target. The scene is laid in the Moscow mansion of Leónid Svedintsef, a landed proprietor and an ardent spiritualist. He is addressed by three peasants from the province of Kursk who are commissioned by their commune to buy land from him and to pay for it by instalments. Svedintsef insists that the whole amount be paid at once. The peasants have friends among the servants, and are promised that the master shall sign the paper that they desire. So Tanya the chambermaid and Semyon the kitchen-boy arrange a spiritualistic séance, in which the latter appears as a medium, and which the master attends with enthusiasm. His credulity rises to the occasion, and, when directed by the medium, he of course signs the paper granting the peasants their request.

Much of the fun of the play arises from frequent and unexpected encounters between the peasants and the lady of the house, who has a horror of disease germs and who is convinced that in the garments of these creatures lurk the

FRUITS, TROPICAL



1 Tamarind fruit

2 Jack fruit

3 Mangoes

germs of various dreadful diseases. The subplot concerns the fortunes of Tanya and Semyon, who are to be married, and who agree that the only real life is life in the country, where they propose to live. The list of characters include doctors, princes and other nobles, cooks and other servants, all of whom are differentiated with Tolstoi's masterly skill. It is all capital comedy and capital satire, has often been presented on the European stage, in Russian, in French and in German. It was first translated into English (from the French) by George S. Schumm in 1891, and is also included in the works of Tolstoi as translated by Nathan Haskell Dole, by Louise and Aylmer Maude, by Leo Wiener and by Mrs. Constance Garnett.

NATHAN HASKELL DOLE.

FRUMENTIUS, Saint, founder of the Abyssinian Church: b. about 300; d. about 360. He was a native of Phœnicia, and, according to Rufinus, when a young man set out for India with his brother Edesius and their uncle Meropius on a commercial voyage. The party fell into the hands of the Ethiopians on the shore of the Red Sea. All were put to death, with the exception of Frumentius and Edesius, who became slaves of the king. They were well treated, gained their freedom in time and rose to great influence in the land. After the death of the king, Frumentius became instructor to the young Prince Aizanes. He formed a Christian congregation with the help of visiting Christian merchants. Edesius returned to Tyre and became a presbyter. Frumentius went to Alexandria and was consecrated bishop of Axum in 328 by Athanasius, who in his 'Epistola ad Constantinum' mentions the consecration and gives some details of Frumentius' mission. Frumentius' day is celebrated on 27 October by the Latin, and on 18 December by the Abyssinian Church.

FRUNDSBERG, or **FRONSPERG, Georg von,** German soldier: b. Mindelheim, Swabia, 1473; d. 1528. In his youth he served in the campaign of the Hapsburgs against Switzerland and in Italy in the struggle between Cambria and Venice. In 1519 he became commander of the infantry of the Swabian League. He fought at Pavia in 1525. Through his services to Maximilian in organizing the pikemen he became known as "the Father of the German *Landsknechte*" (pikemen). Consult Barthold, 'Georg von Frundsberg' (Hamburg 1833), and the life in Latin by Adam Reissner (Frankfort 1568; German trans. 1572).

FRY, Sir Edward, English jurist: b. Bristol, 4 Nov. 1827; d. Failand House, near Bristol, 19 Oct. 1918. He was educated at Bristol College and at University College, London. He became a barrister in 1854, and Queen's counsellor and bencher of Lincoln's Inn 1869. He presided over the Royal Commission on the Irish Land Acts 1897–98; acted as conciliator in the South Wales colliery dispute 1898. He was legal assessor to the International Commission on the North Sea incident 1904–05; arbitrator between the United States and Mexico in the Pious Funds case 1902, and between France and Germany on the Casa Blanca incident 1909, and in many other local and international cases. From 1900 to 1912 he was a member of the Permanent Court of Arbitration at The Hague, and in 1907 was the first British plenipotentiary to The Hague Peace Conference. His published works include 'Essays on the Accordance of Christianity with the Nature of Man' (1857); 'The Doctrine of Election, an Essay' (1864); 'A Treatise on the Specific Performance of Contracts' (1858; 5th ed., 1911); 'British Mosses' (2d ed., 1908); 'James Hack Tuke' (1899); 'The Mycetozoa' (2d ed., 1915); 'Studies by the Way' (1900); 'The Liverworts' (1911).

FRY, Elizabeth Gurney, English philanthropist and prison reformer: b. Norwich, England, 21 May 1780; d. Ramsgate, Kent, 12 Oct. 1845. Brought up a Quaker by her family she did not adapt her mode of life to that prescribed by the more rigid and orthodox of the sect, till 1798, being then induced to do so by the preaching of William Savery, an American Friend traveling in England on a religious mission. This change was consummated by her marriage in 1800 with Joseph Fry, himself a "plain Friend." In 1810 Mrs. Fry became an occasional preacher and thenceforward devoted herself to offices of the purest benevolence and piety. Owing to her unwearied exertions, important reforms were effected in the prison systems, not only of Great Britain, but also in those of France and Germany. Consult 'Memoirs' by Thompson (1846); Corter (1853).

FRY, James Barnet, American military officer: b. Carrollton, Green County, Ill., 22 Feb. 1827; d. Newport, R. I., 11 July 1894. He was graduated at the United States Military Academy in 1847, and after serving as assistant instructor at West Point, he was assigned to the 3d Artillery, then in Mexico, where he remained till the close of the war. In 1863 he was appointed provost marshal-general of the United States, with headquarters at Washington, D. C.; and in 1864 was promoted brigadier-general. He was brevetted major-general in the regular army, 13 March 1865, for "faithful, meritorious, and distinguished services," and after the war served in the divisions of the Pacific, the South, the Missouri and the Atlantic, till 1881, when he was retired. He was the author of 'The History of Brevets'; 'The Army under Buell.'

FRY, William Henry, American composer and journalist: b. Philadelphia, August 1815; d. Santa Cruz, W. I., 21 Dec. 1864. He early showed a singular aptitude for music, and in 1835 produced four overtures which were performed by the Philharmonic Society of Philadelphia, who presented the composer with an honorary medal. He next wrote the operas of 'Aurelia' and the 'Bridal of Dunure.' In 1845 he brought out his opera of 'Leonora,' an Italian version of which was performed in 1858 in New York. In 1846 Fry visited Europe as the correspondent of several American newspapers, and after his return in 1852 gave his attention to music, producing several symphonies of merit. In 1855 appeared his next work, a 'Stabat Mater,' brought out at the New York Academy of Music. He subsequently became attached to the editorial staff of the New York *Tribune*, and attained much popularity as a public lecturer.

FRYATT CASE. On 20 March 1915 Capt. Charles Fryatt, commanding a British vessel, was attacked by the German submarine, U-33, off the coast of Holland and called upon to surrender. Instead, Fryatt turned his ship and attempted to ram the submarine, which escaped by quickly diving. Both Fryatt and his chief officer were each rewarded with a gold watch by the British Admiralty for bringing the vessel safely through. In the following year Fryatt was in command of the British steamer *Brussels* when he was captured by German torpedo boats on 27 July 1916. Taken to Antwerp, he was brought before a German court-martial at Ghent and charged with illegally — as a civilian — attacking a submarine. Fryatt confessed that he had acted under government instructions. He was found guilty and summarily shot as a *franc-tireur*. The execution aroused intense indignation in England and was regarded as on a level with that of Nurse Cavell (q.v.). The ensuing controversy between the British and German governments was carried on through the medium of the American Ambassador, Mr. Gerard.

FRYE, Alexis Everett, American educator: b. North Haven, Me., 2 Nov. 1859. He was graduated at the Cook County Normal School, Chicago, 1885, and from Harvard Law School in 1890. In 1883–86 he was teacher of methods and practice at the Chicago Normal School and from 1886 to 1890 lectured on educational topics. He was admitted to the Massachusetts bar in 1890 and in 1891–93 was superintendent of schools at San Bernardino, Cal. He was appointed superintendent of schools in Cuba by the Secretary of War in 1899. He organized the public-school system of the island in 1899–1901 and conducted the Cuban teachers' expedition, bringing 1,284 native teachers to the United States in 1900. He was captain in the Harvard University Battalion in the Spanish-American War. He has published 'Child and Nature' (1888); 'Brooks and Brook Basins' (1891); 'Mind Charts — Psychology' (1891) and a number of school geographies.

FRYE, William Pierce, American lawyer, legislator and statesman: b. Lewiston, Me., 2 Sept. 1831; d. Lewiston, 8 Aug. 1911; son of Col. John M. and Alice M. Frye. He was graduated at Bowdoin College in 1850 and after studying law in the office of William Pitt Fessenden, he began practice at Rockland, and later at Lewiston. He was elected to the State legislature from the latter city in 1861, 1862 and 1867. In 1864 he was a presidential elector on the Lincoln ticket. After serving a term as mayor of Lewiston, he was elected attorney-general of the State, on the Republican ticket, holding the office from 1868 to 1870. He was elected to Congress from his home district in 1871, and was re-elected no less than five times.

In 1881 he resigned his seat in the House of Representatives to accept the nomination to the United States Senate, filling the vacancy caused by the resignation of James G. Blaine, who entered Garfield's Cabinet as Secretary of State. Senator Frye was re-elected to the Senate in 1889, 1895, 1901 and 1907; was elected president pro tem. of the Senate in 1896, and has twice acted as permanent presiding officer of that body — after the death of Vice-President Hobart in 1899, and after the elevation of Vice-President Roosevelt to the Presidency in 1901. After the close of the Spanish-American War Senator Frye was a member of the Peace Commission in Paris. He was chairman of the Commerce Committee in the Senate and has exerted a great influence on national legislation. He was looked upon as one of the great leaders of the Republican party, and had much to do with framing legislation on the tariff and as regards American shipping. During the exciting days of the Spanish-American War he acted as chairman of the Senate Committee on Foreign Relations. Senator Frye was given the degree of LL.D. by Bowdoin College in 1889, and also by Bates College in 1881.

FRYER, John, American Orientalist: b. Hythe, Kent, England, 6 Aug. 1839. He was graduated at Highbury College, London, in 1860; (LL.D. Alfred University, N. Y.). He was principal of Saint Paul's College, Hongkong, 1861–63; and professor of English at Tung-Wen College, Peking, China, 1863–65; and head-master of the Anglo-Chinese School, Shanghai, China, 1865–67; head of department for translation into Chinese of foreign scientific books at Imperial Government Arsenal, Shanghai, 1867–96; general editor and other offices of Educational Association of China 1887 to 1896; founder and proprietor of Chinese Scientific Book Depot, Shanghai, 1874; Viceroy's Examiner at Imperial Naval College, Nanking, 1894–95; traveling secretary to Chinese Ambassador, Kwo-Sung-Tao, 1878. Editor of Chinese newspaper, *Shanghai Sinpao,* 1866-67. Honorary member Northern China Branch Royal Asiatic Society in 1867; Agassiz professor of Oriental languages and literature, 1895–1915; professor emeritus, 1915; president Oriental Institute of California since 1904. Founder of the Institution for the Chinese Blind, Shanghai, China, 1912; editor and proprietor of Chinese *Scientific and Industrial Magazine,* Shanghai, 1876–84; Third degree of Chinese brevet civil rank, 1872; First Rank of Third Degree, Imperial Order of the Double Dragon, 1878. He is author or translator of upwards of 100 books in the Chinese language published at Shanghai, as well as articles, essays, reports, etc., in English; and the first 'Educational Directory for China' (1896); various vocabularies of scientific terms in English and Chinese, etc.

FRYKEN, frĭ'kĕn, a series of small lakes north of Lake Wenern, Sweden. They are connected by narrow channels and drain southward into Lake Wenern. They are famed for their scenic attractions.

FRYXELL, Anders, Swedish historian: b. Hesselskog, Dalsland, 7 Feb. 1795; d. Stockholm, 21 March 1881. He was educated at Upsala, took holy orders in 1820, became instructor at the Djurgårdskole, Stockholm, in 1819, and at the Maria-Skole in 1822. He was rector of the latter in 1828–36. In 1823 he began his great work 'Stories from Swedish History'; the work occupied much of his time for 56 years and was issued in 46 volumes. His style is picturesque and his popularity among all classes is due to his faculty of awakening a national sense in his readers. He published a 'Swedish Grammar' in 1824, which long remained a standard. He was made pastor at Sunne in 1835 and was elected to the Swedish Academy in 1840. In 1847 he received permission to devote himself exclusively to historical research. His other works include 'Characteristics of Sweden between 1592 and 1600' (1830); 'Origins of the Inaccuracy with which the History of Sweden in Catholic Times has been Treated' (1847); 'Contributions to the Literary History of Sweden' (1862); 'The Rôle of the Aristocracy in Swedish History' (1850); 'Studies in Swedish History' (1843). In 1884 his daughter, Eva Fryxell, published from his manuscripts an autobiography, 'History of My History.' It is now recognized that Fryxell's labors were rather of a popular than of a scientific order and threaten to become obsolete despite their great popularity.

FTELEY, Alphonse, American civil engineer: b. Paris, France, April 1837; d. Yonkers, N. Y., 6 Aug. 1903. He was educated at the Ecole Polytechnique, Paris, and came to the United States in 1865. He was resident engineer of the waterworks bureau of Boston (1873–80); chief assistant city engineer of Boston (1880–84), and subsequently consulting engineer. He was also chief engineer of the New York Aqueduct Commission (1888–1900). In the last-named capacity he planned the Croton dam in 1891, and the Jerome Park reservoir in 1894. At various times he acted as consulting engineer on municipal waterworks and extensions in Brooklyn, Newark, Hoboken and on the Passaic Sewerage District, the Hoosac tunnel and the rapid transit systems of Boston and New York. He was a member of the American Society of Civil Engineers, its president in 1898 and a contributor to its 'Transactions.'

FU-HI, or FO-HI, Chinese legendary hero, whose reign began about 2852 B.C. He was the first of the Wu-Ti, or "Five Rulers," and is affectionately regarded as the founder of the Chinese nation. He is reputed to have brought the people from a barbarous state to a comparatively high degree of civilization. He was renowned as a law-giver, having instituted marriage and divided the people into 100 clans and forbidding intermarriage within the clan. Much of myth and legend surround his birth, his alleged discovery of writing, etc. He died in 2738 B.C. (See CHINA, *History*). Consult La Conperie, 'Western Origin of the Early Chinese Civilization' (London 1894); Hirth, 'Ancient History of China' (New York 1908); Mayers, 'Chinese Readers' Manual' (Shanghai 1875).

FU-SHAN, foo-shän', **FATSHAN** or **FACHAN,** China, a manufacturing town in the province of Kwang-Tung, 16 miles southwest of Canton, on one of the branches of the delta of the Si-Kiang. It has manufactures of silk, iron and steel, etc., is a busy commercial centre and is called the Chinese "Birmingham," doing an extensive import trade in scrap iron from Europe. Pop. about 500,000.

FUÀ-FUSINATO, foo-ä foo-sē-nä'tō, **Erminia,** Italian poet: b. Rovigo, 5 Oct. 1834; d. Rome, 27 Sept. 1876. She was married to the poet Arnaldo Fusinato (q.v.) in 1856. Her spirited appeals to national sentiment in 1848 brought her widely into notice. In 1852 was published her 'Verses and Flowers.' She wrote a series of 'Stornelli,' advocating Florence as the national capital instead of Rome. Her complete poetical works, 'Versi,' were published in 1879; her 'Literary Writings' in 1883.

FUAD PASHA, Turkish statesman: b. Constantinople, 1814; d. Nice, 1869. He was the son of the distinguished poet Kechéji-zadé Izzet Molla, was educated at Galata-Serai and was at first an army surgeon. In 1836 he forsook medicine and entered the civil service as an official of the foreign ministry. In 1840 he came to London as secretary of the embassy and later was employed on special missions in the principalities and to Petrograd. In 1851 he was sent to Egypt as special commissioner. Later in the same year he became Minister for Foreign Affairs, a post to which he was subsequently appointed four times and which he held at the time of his death. He was in command of the troops on the Greek frontier during the Crimean War and was distinguished for his bravery. He was Turkish delegate at the Paris conference of 1856; was on a mission to Syria in 1860; grand vizier in 1860–61 and later Minister of War. He accompanied the Sultan Abd-ul-Aziz to Europe and was presented with the freedom of the city of London. He was one of the original members of the Turkish Academy of Science and Belles-Lettres and published a Turkish grammar in 1852, which was held in great esteem by Turkish scholars. As Foreign Minister he rendered invaluable services to his government at more than one critical period.

FUCA, Juan de, hoo-än' dä foo'kä (originally APOSTOLOS VALERIANOS), Greek navigator: b. Cephalonia; d. Zante 1602. He was for many years in the Spanish naval service. In 1592, when he discovered the sea-passage separating Vancouver Island from Washington and connecting the Pacific Ocean with the Gulf of Georgia and with Admiralty Inlet and Puget Sound, he thought he had chanced upon a connection between the Atlantic and Pacific oceans. This strait has been called after his name. In 1596 he told an Englishman, Michael Lok, that he had made this discovery and the story found its way to 'Purchas, His Pilgrimes' (1625) and led to renewed efforts in search of a passage between the Atlantic and Pacific oceans. For a criticism of Juan de Fuca's claims consult Bancroft, 'History of the Northwest Coast' (Vol. I, 1884).

FUCA, Strait of. See JUAN DE FUCA, STRAIT OF.

FUCHOW. See FOOCHOW.

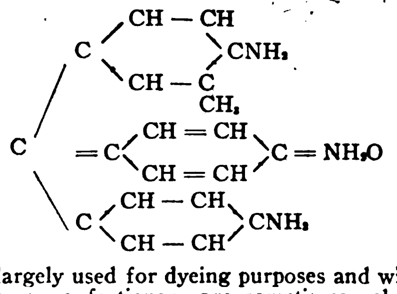
FUCHS, fooks, **Ernst,** German ophthalmologist: b. Vienna, 1851. He was educated in Vienna, was professor at the University of Liége in 1881–86 and in the latter year became professor of ophthalmology at the University of Vienna. He has written several important works, including 'Das Sarcom des Uvealtractus' (1882); 'Die Ursachen und die Verhütung der Blindheit' (1885); 'Lehrbuch der Augenheilkunde' (11th ed., 1907; Eng. trans. by Alexander Duane entitled 'Text-Book of Opthalmology,' 4th ed., 1911).

FUCHS, Immanuel Lazarus, German mathematician: b. Moschin, Posen, 1833; d. 1902. He was appointed professor extraordinary at Berlin in 1866 and became full professor of mathematics at Greifswald in 1869; removed to Göttingen in 1874, to Heidelberg the year following and to Berlin in 1884. He wrote considerable on the theory of functions and on linear differential equations. In 1891 he was made editor of the *Journal für die reine und angewandte Mathematik*. Consult 'Acta mathematica' (Stockholm).

FUCHS, or FUCHSIUS, Leonhard, German botanist: b. Membdingen, Bavaria, 17 Jan. 1501; d. Tübingen, 10 May 1566. He studied the classics under Reuchlin at Ingolstadt and was graduated doctor of medicine in 1524. He afterward turned his attention to botany, of which science he must be looked upon as one of the fathers. In his 'De Historia Stirpium Commentarii Insignes' (1542), he gave a clever description of domestic plants, alphabetically arranged, and laid the foundation of a permanent bontanical nomenclature. The fuchsia (q.v.) was named after him.

FUCHSIA, fū'shĭ-ą or fook'sĭ-ą, a genus of plants, the type of the tribe *Fuchsieæ,* family *Onagraceæ,* named after the botanist, Leonhard Fuchs. The genus contains more than 70 known species, chiefly natives of Mexico, Peru and Chile. Some have been found in New Zealand. The plants are shrubby or arborescent, sometimes climbing; the flowers are pendent, large and fine, with brilliant and delicate coloring — purple, rose and white; the calyx is four-cleft, the corolla four-petaled, the fruit four-celled. The leaves are opposite and verticillate. The flowers are both axillary and terminal, usually one flower springing from the axil, more rarely in racemes at the top of the branches. Fuchsias are much cultivated in conservatories, and are favorite house-plants throughout the United States. They are propagated with great facility from cuttings.

FUCHSINE, fook'sin, an aniline dye prepared by the action of arsenic acid, nitrobenzene or other oxidizing agents upon a mixture of aniline and its homologue toluidine, which yields a mass with a bronze or coppery lustre, called rosaniline. This dissolved in water, precipitated with common salt and the precipitate washed and crystallized from water, forms fuchsine, which in commerce receives various fancy names, as magenta, aniline or new red, roseine, rubine, etc. It is a derivative of triphenylmethane and has the formula



It is largely used for dyeing purposes and wines and even confectionery are sometimes colored with it. It was first prepared by Natanson in 1856, by heating aniline with ethylene chloride.

FUCHSIUS. See Fuchs.

FUCHS' SOLUBLE GLASS. See Water Glass.

FUDGE FAMILY IN PARIS. A satire written by Thomas Moore in 1818, the underbred English in foreign countries being the subject.

FUEGIAN. See Ona; Yahgan.

FUEGO (fwā'gō) **ISLAND.** See Fogo.

FUEL, Comparative Heating Values of. The effective and economical utilization of the inherent heat energy of fuel in the production of light and power is perhaps the most important industrial question of the times. It is one that plays such a necessary part of modern life and the cost of the fuel used oftentimes is so great a factor in the conduct of an industrial enterprise on an economical basis, that constant efforts are being directed to improve the present methods of fuel utilization and approach more nearly the possibilities of theoretical efficiency.

Kinds of Fuel.— Nature furnishes a great variety of fuel in three general forms — the *solid,* such as wood and coal; the *liquid,* such as petroleum; and the *gaseous,* such as natural gas. The solid forms of fuel are the most common; the liquid contain the largest proportion of heat energy; and the gaseous are the most convenient for use and economical of labor. The fact that any kind of gaseous fuel is the most convenient and, in a great many cases, the most effective for use, has been demonstrated principally through the utilization of natural gas; but as the supply of natural gas is gradually failing and the cost of oil-firing is much higher, the tendency of the times is to perfect methods for the conversion of solid and liquid fuel into gaseous form. These conditions render the methods of firing employed very important.

Methods of Firing.— In general, the economical and effective utilization of a fuel depends upon the completeness of the combustion thereof. In the combustion of solid facts by ordinary grate or "direct firing" methods the greater part of the heat liberated is lost in the form of gases which are not combustible at the temperatures attained in grate-fired furnaces. On the other hand, when solid fuel is first converted into gas and the gas thus obtained utilized by "gas firing" methods, the results accomplished more than compensate the 15 or 20 per cent loss of heat energy sustained by the process of conversion. As generally applied, gas firing results in more complete combustion and the attainment of higher combustion temperature and thereby make possible metallurgical operations which are impracticable with direct firing. There is also less loss of heat through the waste products of combustion and greater efficiency in transfer of heat. Furthermore, by suitable methods, the heat from the hot waste gases can be recovered and returned to the combustion chamber in preheated air, so that the gas and air supply, and therefore the combustion of the fuel, are placed under easy and complete control.

In practice, the theoretical amount of air necessary for complete combustion is always exceeded. Direct firing requires at least twice the theoretical amount to even approximate complete combustion, especially in the use of soft coals. With the progress of combustion, the fuel bed becomes more compact, so that with a given draught the amount of air penetrating into the bed decreases with the increase of the depth and compactness of the fuel. Under these conditions, a fresh charge of coal requires a greater amount of air to consume its volatile components and demands it at a time when its passage is most retarded and the combustion rendered more incomplete by the reduction of temperature accompanying volatilization. As the final result is an irregular air demand, the grates have to be arranged to admit the greater excess of air at all times, otherwise large heat losses will occur from the escape of unconsumed gases.

On the other hand, in gas firing, the air supply is always under control and therefore can be made to approximate closely the theoretical amount, thus reducing the bulk of the products of combustion and ensuring more complete combustion. The greater amount of heat then liberated is concentrated in smaller volume, and raises the temperature of combustion, so that the oxygen of the air combines more readily with the combustible constituents of the gas. Furthermore, the smaller the excess of air the less the dilution of the gaseous mixture by nitrogen and other inert gases which retard combustion.

The products of combustion being of a higher temperature transmit their heat more readily, and being smaller in quantity carry off less heat by way of the chimney. By suitable arrangements, these products may be intercepted and forced to impart a large amount of their heat to the air supply going to the combustion chamber, thus returning a certain amount of heat to the system, which represents a saving in fuel equivalent to the amount of heat so returned.

Therefore, in considering any fuel the primary question does not relate to the calorific value of the fuel so much as to what percentage of the heat energy represented by its calorific value is actually available for conversion into mechanical energy according to the manner of its utilization.

The latest experience shows, that in the case of a modern steam plant, burning coal by direct firing, the economy lies behind the stop valve, rather than in reducing the consumption of steam.

According to the best authorities, the mechanical arrangements and conditions most favorable for the most economical utilization of solid fuel are as follows: the height of the chimney should not be less than 120 feet, nor more than 180 feet, giving a natural draught ranging from 0.50 to 0.83 inches of water, with an average temperature of 300° F. For Lancashire boilers (full size) the chimney area should equal six square feet per boiler up to a total of four boilers and five square feet per boiler for every additional boiler. The area of the chimney entrance should be 10 per cent in excess of this amount and the flue should enter the chimney with a rising slope of not less than 45 degrees. The area through the economizer should be 20 per cent greater than the flue area and the economizer walls should be at least 14 inches thick and exceptionally well built and the combined area of the boiler side flues should not be less than twice that of the main flue.

As the price of fuel is influenced to a great extent by the convenience with which it can be burned, the general tendency is to use a higher priced fuel even though it may have a lower heating value than a cheaper grade. This tendency can be readily overcome and a large reduction made in the fuel bill by the use of high-class mechanical stokers which will burn coal almost impossible to fire by hand.

General Descriptions of Fuel.— For various reasons coal is the most important of all fuels and in many localities constitutes the only one available; but in some places wood, oil and gas are abundant and take the place of coal. In certain industrial and manufacturing plants, their waste products, such as straw, tanbark, sawdust and bagasse are used as fuel more economically than coal, owing to their availability. For general purposes, however, coal is the chief fuel and the available heating value of all other kinds of fuel are invariably expressed in terms of that of coal.

Solid Fuels.

Varieties of Coal.—The five most important varieties of coal are anthracite, dry bituminous, caking bituminous, cannel and lignite.

Anthracite coal is found principally in the Alleghany Mountains and in the Rocky Mountain region in Colorado. It is a hard, lustrous variety and breaks up easily at a high temperature. It consists of 93 to 95 per cent carbon and 2 to 4 per cent hydrogen and burns with very little flame and smoke, unless containing an excess of moisture and gives an intense heat. There is a variety known as semi-anthracite which contains 90 to 93 per cent carbon and 4 to 5 per cent hydrogen, but it is not as hard as true anthracite and burns with a short flame. Owing to its great brittleness, a large part of anthracite gets broken into small pieces; therefore, in order to obtain the best results it should be fired on grates having small air spaces. The various commercial names and sizes of anthacite coal used in industrial furnaces are as follows:

«Chestnut» coal passes over a round hole seven-eighths of an inch in diameter and falls through a hole one and one-half inches in diameter. «Pea» coal passes over a hole nine-sixteenths of an inch in diameter and falls through a hole seven-eighths of an inch in diameter. «Number One Buckwheat» passes over a hole three-eighths of an inch in diameter and falls through a hole nine-sixteenths of an inch in diameter. «Number Two Buckwheat» or «Rice» passes over a hole three-sixteenths of an inch in diameter and falls through a hole three-eighths of an inch in diameter. «Number Three Buckwheat» or «Barley» passes over a hole three-thirty-seconds of an inch in diameter and falls through a hole three-sixteenths of an inch in diameter. «Dust» includes all that falls through a hole three-thirty-seconds of an inch in diameter. The size of coal used has a considerable influence on the amount of heat produced, owing to its effect on the draft. With a poor draft, fine coal is consumed too slowly to be effective. Coal is most efficiently used in separate sizes, which afford regularity of draft, whereas mixed sizes have the effect of choking the fire.

Bituminous coal contains less carbon and more hydrogen than is found in anthracite. The dry variety is found in Maryland and Virginia and the caking variety chiefly in the Mississippi Valley. Dry bituminous coal contains 84 to 89 per cent carbon and 5 to 6 per cent hydrogen and burns freely, without caking and with very little smoke. The caking coals become pasty or swell and cake when burning. Caking bituminous coals contain from 80 to 85 per cent carbon and 5 to 6 per cent hydrogen and are largely used for making illuminating gas.

Cannel coal, also known as long-flaming bituminous, contains from 65 to 85 per cent carbon and 5 to 8 per cent hydrogen. It is found in Pennsylvania, Indiana and Missouri. All varieties of cannel coal have a strong tendency to smoke and some of them cake when heated.

Lignite, also known as brown coal, contains from 55 to 75 per cent carbon and 5 to 6 per cent hydrogen. It is found in the Dakotas, Colorado, Texas, Washington and Alaska. It is a substance intermediate between peat and coal and contains some moisture and mineral matter. The poorer varieties have a low fuel value.

Peat consists of decayed roots and foliage consolidated into earthy matter. It is cut out of bogs and swamps and then dried, usually by being stacked in the air. If it is sufficiently compact it is burned without being previously compressed; otherwise, it is pulverized and compressed into briquettes, and sold as an artificial fuel. The amount of ash varies from 5 to 12 per cent. Recent experiments in the carbonizing of peat have greatly increased its value as an effective fuel. It is transformed into peat charcoal by the process used in making wood charcoal and into peat coke or semi-coke in special apparatus. In powdered form peat has been used successively as a locomotive fuel on the Swedish national railways, the powder being blown into the fire with an air-blast. A small percentage of powdered bituminous coal is added to the peat powder. In the semi-coke process the peat is pulverized in water, carbonized and then pressed into briquettes. Peat charcoal has a calorific value of about 12,500 B. T. U. per pound and peat coke a calorific value of 14,500 B.T.U. per pound.

The value of a fuel is indicated by the number of heat units it contains. This heating value is expressed in British thermal units (generally abbreviated to B. T. U.). This unit is the amount of heat required to raise one pound of water one degree Fahrenheit from a starting point of 60°.

Coke is an artificial fuel obtained from bituminous or semi-bituminous coals by driving off their hydro-carbon constituents by means of heat. As the by-products of gas retorts, commercially known as gas-house coke, it has a low fuel value under direct firing methods; but it will make a very hot fire under forced draught. It contains about 60 per cent carbon and 1 to 2 per cent hydrogen.

Briquettes are made by pressing into blocks of varying shapes and sizes fine coal and coal dust mixed with tar, asphalt, pitch, molasses residues and similar materials as binders. At first prohibitory on account of manufacturing cost they have come more and more into favor as coal has advanced in price. In the United States alone, in 1917, there were 13 plants engaged in making briquettes. They used 402,336 tons of fuel material which otherwise would have been valueless, and turned out 406,856 tons of briquetted fuel, valued at $2,233,888 — an average value of $5.48 per ton. The calorific value of briquettes is from 13,700 to 14,600 British thermal units per pound.

Thermal Units.— The number of British thermal units (B.T.U.) per pound of fuel in some of the more common kinds of coal are as follows: Pennsylvania anthracite, 13,100 to 14,200; Pennsylvania Connellsville coal, 13,640; Pennsylvania semi-bituminous and cannel coal, 13,150; Pennsylvania brown coal or lignite, 12,300; Kentucky bituminous, 14,400; Kentucky cannel, 15,200; Kentucky lignite, 9,300; Indiana bituminous, 14,160; Indiana cannel, 13,100; Virginia bituminous, 13,100; Virginia Pocahontas, 14,800; West Virginia bituminous, 13,740; southwestern Illinois, 12,800; Missouri bituminous, 13,550; Ohio bituminous, 12,300; Maryland Cumberland, 12,200; Arkansas lignite, 9,200; Colorado lignite, 13,560; Texas lignite, 13,000; Washington lignite, 11,550; peat, air-dried, 7,400; peat, kiln-dried, 10,200 to 12,200; coke (average), 14,700. Many other examples are given in Bulletin 23 of the United States Bureau of Mines. Coals which have a high moisture content or a high percentage of ash develop their best fuel results when used in a gas producer. The calorific value of any sample of coal may be roughly determined by the formula $14{,}600\ C + 56{,}000\ (H - \frac{O}{8}) + 4{,}000\ S$. where the letters stand for the molecular weights of those elements — the result being in British thermal units per pound.

Wood, considered as fuel, is divided into two classes — hard wood and soft wood. The heating value of different kinds of wood for a given weight is practically the same; or, in other words, one pound of hickory is not worth any more as fuel than one pound of pine, as the chemical composition of different kinds of wood is nearly the same. Wood, however, is usually purchased by the cord, and the hard woods are very much heavier per cord than the soft woods. Hickory and hard maple weigh about 4,500 pounds per cord, equal to 1,800 pounds of coal; white oak weighs 3,850 pounds, equal to 1,540 pounds of coal; birch and the red and black oaks weigh 3,250 pounds, equal to 1,300 pounds of coal; poplar, chestnut and elm weigh about 2,350 pounds per cord, equal to 940 pounds of coal; pine weighs about 2,000 pounds per cord, equal to 800 pounds of coal. The average chemical composition of air-dried wood shows 37.5 per cent of carbon; 4.5 per cent of hydrogen; 30.75 per cent of oxygen; and 1.5 per cent of ash, with a moisture content ranging from 15 to 25 per cent. Its fuel value is about 5,800 British thermal units per pound. For some purposes wood is kiln-dried, increasing its fuel value to 7,800 British thermal units per pound; but such wood, if kept for any length of time, absorbs from the air the moisture driven out, and falls again into the class of ordinary air-dried wood. Selected resinous wood, such as pine knots, give as high a fuel value as 10,800 British thermal units per pound. In estimating relative fuel values it is customary to reckon one pound of coal as equivalent to two and one-half pounds of wood.

Spent tan-bark is commonly used in the furnaces of tanneries and yields about 4,500 British thermal units per pound. **Straw** is sometimes burned as fuel under boilers and yields about 5,500 British thermal units per pound.

Charcoal is made by evaporating the volatile constituents of wood, either by partial combustion or by heating in retorts. By partial combustion as in a common charcoal kiln, 100 pounds of wood will yield 20 pounds of charcoal, and by heating in a retort about 30 pounds. A cord of wood generally yields about 50 bushels of charcoal. Since the non-combustible constituents of the wood are driven off in the process of making charcoal, the latter has a high calorific value, ranging from 11,000 to 13,500 British thermal units per pound.

On account of the large per cent of moisture in peat, wood, sawdust and tan-bark, these substances as well as coke and charcoal, are rarely used for steaming or power-producing purposes, but all of them are available as fuel in gas producers, by the use of which the moisture is readily removed from the constituent gases, which can then be used for power-producing purposes by means of internal combustion engines, or be burned directly in furnaces where high temperatures are required, such as those of steel works, rolling mills, smelting furnaces, glass works and chemical works.

Liquid Fuels. Among liquid fuels the oils derived from petroleum occupy practically the whole division. In application they are used in two ways: in external combustion and much more extensively in internal combustion engines. While the so-called heavy oils are generally devoted to the external oil-firing and the lighter oils to the internal combustion type of motor, there is actually no distinct division as to availability, if there is a suitable adaptation of burners. Closely allied to the lighter petroleum oils is benzol, a by-product of the manufacture of coke. Tars derived from gas works, coke ovens and blast furnaces are much used in engines of the Diesel type. The only other liquid fuel which approaches industrial importance is alcohol.

Fuel Oils.— The various kinds of fuel oils are all derived from petroleum, varying in composition as follows: Carbon, 82 to 87 per cent; hydrogen, 11 to 15 per cent; oxygen, ½ to 6 per cent. The theoretical average calorific value is about 20,860 B. T. U. per pound, corresponding to a theoretical evaporation of 21 pounds of water from and at 212° Fahr.

American crude petroleum carries more of the lighter oils than the European, Mexican or Peruvian, from which a residuum or fuel oil, consisting largely of the heavy oils, is obtained by distillation. To be effective fuel oils must be vaporized and thoroughly mixed with the proper proportion of air. In this work steam atomizers give better results than the air spray, the steam required to atomize being about 4 per cent of the water evaporated.

«Astatki,» «Mazoot,» «distillate,» «petroleum refuse,» «reduced oil,» etc., are some of the commercial terms used to designate the various kinds of fuel oil.

Approximately, one pound of fuel oil is equal to 1.45 pounds of coal. A test at the Minneapolis waterworks showed that for the same duty 224 gallons of oil, weighing 6.875 pounds per gallon, equaled one ton (2,240 lbs.) of Youghiogheny coal.

Fuel oils have both advantages and disadvantages. The heating value of a fuel oil is nearly twice its weight of coal. Its use is not as injurious to the furnace as the use of coal, on account of the smaller percentage of sulphur. With oil, the fire can be controlled by means of a single valve and when once regulated to produce a certain heat, it can be maintained at that point with very little trouble. There is a much lower temperature in the fireroom, particularly noticeable on shipboard. The fire can be started easily and extinguished instantly. The combustion is complete and smokeless, thus making economy and cleanliness important advantages in its use. And there is a very considerable saving in labor, one man with oil taking the place of eight men with coal.

The most important disadvantages are the comparatively high price, danger from explosion, loss by evaporation and unpleasant odor.

The barrel of crude petroleum of commerce is 42 gallons, weighing six and one-half pounds per gallon, and it is customary to consider roughly that three and three-quarters barrels are equivalent to one ton of coal.

The requirements of a desirable fuel oil are: high calorific value — at least 18,000 B. T. U.; specific gravity within 0.85 to 0.97 at 60° F.; high flash point — not lower than 150°; and if for shipboard use, not lower than 175°, and 200° preferred; viscosity low enough to remain liquid at 32° and to flow freely with one foot head in a four-inch pipe; freedom from water (2 per cent highest exception); freedom from sulphur (1 per cent highest exception); freedom from dirt; and freedom from acid (one-twentieth of 1 per cent highest exception).

Tar Fuels.— Tar fuels are of two classes: the high temperature tars and the low temperature tars. The former are products of the horizonal gas retorts, are quite viscid and contain a high percentage of the objectionable naphthalene, and about 19 per cent of free carbon. Low temperature tars are the products of vertical gas retorts and blast furnaces manufacturing coalite and coke. The latter produce tars which are quite fluid, contain but small percentages of napthalene and anthracene and almost no free carbon. The tar from the vertical gas retorts is of the same general character, but has a larger proportion of naphthalene and about 3 per cent of free carbon. In some cases the tars are first distilled to secure their benzol content.

As fuel, tar is much less desirable than the oils because of its content of oxygen compounds (carbolic acid, cresylic acid, etc.), which not only reduce its calorific value but evolve noisome fumes. The average composition of tar is about as follows: carbon, 78 per cent; hydrogen, 6 per cent; sulphur, 1 per cent; nitrogen, 1 per cent; oxygen, 14 per cent. Its calorific value is about 15,800 B. T. U. per pound. The flash point of tar varies from 100° to 115° F. for vertical retort tar to 160° to 190° for horizontal retort tar.

Benzol.— Benzol appears upon the market in two grades — 90 per cent benzol and 50 per cent benzol; also in mixtures of the two. The 90 per cent grade is the only one used to any extent as a fuel and this use is confined almost wholly to internal combustion motors, where it very successfully takes the place of the higher priced gasoline and yields about 12 per cent more heat gallon for gallon — and without any change in the motor. The calorific value of benzol is 17,500 B. T. U. per pound (156,700 B. T. U. per gallon).

Alcohol.— It has been truly said of alcohol that, in the present state of the world's knowledge, it is the only fuel which man is able to manufacture in unlimited quantities and within a reasonable time, without drawing upon the reserves of natural fuels; and this is especially important as to those parts of the earth where there are no natural fuel deposits. Alcohol is easily produced from any form of vegetable growth containing sugar or fermentable starch and at a cost of about 21 cents per gallon from such relatively costly material as the sugar cane and the sugar beet — which may be grown in four months. The so-called gasoline motors run readily on 84 per cent alcohol (a higher degree has been found of no advantage) without material change in the mechanism. The only difficulties to be overcome are those of starting from the cold, and the necessity of a more abundant supply of fuel than with gasoline. The calorific value of fuel alcohol is about 11,500 B. T. U. per pound (91,100 B. T. U. per gallon). With alcohol, internal combustion motors show a somewhat higher efficiency than with gasoline and run with much less noise.

Gaseous Fuels.

The principal kinds of gaseous fuel which are in use at the present time for power-producing purposes are natural gas and producer gas. A certain kind of uncarburetted water gas, made by the decomposition of steam in the presence of incandescent-carbon, is also used to a limited extent, but this gas can never play a very important part as a power producer, on account of the large consumption of energy in its production.

The composition, weight and heat value of 1,000 cubic feet of the four types of gases used for power producing and illuminating purposes are as follows:

Natural Gas.— Marsh gas, 92.6 per cent; nitrogen, 3.61 per cent; hydrogen, 2.18 per cent; carbon monoxide, 0.50 per cent; oxygen, 0.34 per cent; olefiant gas, 0.31 per cent; carbon dioxide, 0.26 per cent. Natural gas weighs about 45.6 pounds per 1,000 cubic feet. Its calorific value is 1,100,000 B. T. U. per 1,000 cubic feet.

Coal Gas, or Illuminating Gas.— Hydrogen, 46.0 per cent; marsh gas, 40.0 per cent; carbon monoxide, 6.0 per cent; olefiant gas, 4.0 per cent; nitrogen, 1.5 per cent; oxygen, 0.5 per cent; carbon dioxide, 0.5 per cent. Coal gas weighs about 32 pounds per 1,000 cubic feet. Its calorific value is 735,000 B. T. U. per 1,000 cubic feet.

Water Gas.— Hydrogen, 45.0 per cent; carbon monoxide, 45.0 per cent; carbon dioxide, 4.0 per cent; marsh gas, 2.0 per cent; nitrogen, 2.0 per cent; oxygen, 0.5 per cent. Water gas weighs about 45.6 pounds per 1,000 cubic feet. Its calorific value is 322,000 B. T. U. per 1,000 cubic feet.

Producer Gas (from bituminous coal).— nitrogen, 55.3 per cent; carbon monoxide, 27.0 per cent; hydrogen, 12 per cent; marsh gas, 2.5 per cent; carbon dioxide, 2.5 per cent; olefiant gas, 0.4 per cent; oxygen, 0.3 per cent; Producer gas weighs about 65.9 pounds per 1,000 cubic feet. Its calorific value is 156,900 B. T. U. per 1,000 cubic feet.

This exhibit shows natural gas to be the highest in the order of heat energy, its calorific power being 50 per cent greater than that of coal gas. This is due to the high percentage of marsh gas given to natural gas by a natural process which cannot be duplicated artificially. Producer gas has the lowest heat value, yet it is the cheapest artificial fuel gas per unit of heat, as the oxygen for burning the carbon to carbon monoxide is derived principally from the air. It has only one-fifth the heat energy of good illuminating gas per cubic foot, and it is most successfully applied in operations where a considerable body of gas is burned rather than in small operations where illuminating gas can be used to superior advantage.

Comparison of Gases on a Coal Basis.— The theoretical heat value of average anthracite coal is about 14,200 B. T. U.'s per pound, or the power to evaporate about 14.7 pounds of water per pound of coal burned. This theoretical evaporation is never attained in practice, however, owing to heat losses sustained in various ways — by improper design of boilers, by radiation, by improper firing, etc., so that a boiler rarely gives an efficiency equivalent to the evaporation of 12 pounds of water per pound of coal, or the utilization of 80 per cent of the theoretical heat energy of the fuel. The efficiency usually attained is about 10 pounds of water, or about 67 per cent of the theoretical energy, so that only about 9,500 of the 14,200 heat units in a pound of coal are utilized by the average boiler.

As determined by satisfactory experiments, seven and one-half cubic feet of natural gas burned will evaporate 10 pounds of water; or in other words, about 8,000 heat units in the form of natural gas are equivalent to a pound of good coal burned. Other authorities give the heat value of 1,000 cubic feet of natural gas as equivalent to that of an amount of coal ranging from 80 to 130 pounds.

Comparison of Illuminating Gas and Producer Gas.— First-class coal gas, or carburetted water gas, made with four and one-half gallons of Lima oil per 1,000 feet of gas, contains between 730 and 735 heat units per cubic foot, which gives an equivalency of 19 cubic feet of gas to one pound of anthracite coal, or 1,000 cubic feet equal to 59 pounds of coal.

One pound of anthracite coal, composed of carbon 85 per cent, hydro-carbons 5 per cent, and ash 10 per cent, will make 90 cubic feet of producer gas of the following composition: hydrogen 12 per cent, carbon monoxide 27 per cent, marsh gas 1.2 per cent, carbon dioxide 2.5 per cent, and nitrogen 57 per cent, having a heat value of 137 heat units per cubic foot. This gives an equivalency of about 104 cubic feet of gas to one pound of anthracite coal, or 1,000 cubic feet to about 9.5 pounds of coal.

Comparison of Anthracite Gas and Bituminous Gas.— One hundred pounds of anthracite coal converted into gas in a gas producer yields 186.66 pounds of carbonic oxide, equivalent to 807,304 B. T. U.; 5 pounds of marsh gas, equivalent to 117,500 B. T. U.; and 3.75 pounds of hydrogen, equivalent to 232,500 B. T. U.;— a total of 1,157,304 B. T. U. The total energy per pound of gas is 2,248 B. T. U. Since the total energy in 100 pounds of anthracite is 1,349,000

B. T. U., its conversion into gas shows an efficiency of 86 per cent.

One hundred pounds of bituminous coal converted into gas in a gas producer yields 116.66 pounds of carbonic oxide, equivalent to 504,554 B. T. U.; 32 pounds of volatile hydrocarbons, equivalent to 640,000 B. T. U.; and 2.5 pounds of hydrogen, equivalent to 155,000 B. T. U.— a total of 1,299,554 B. T. U. The total energy per pound of gas is 3,484 B. T. U. As the total energy in 100 pounds of bituminous coal is 1,437,500 B. T. U., its conversion into gas shows an efficiency of 90 per cent.

In view of the facts that the supply of natural gas is gradually failing, and that the most satisfactory method of using the heat from other fuels is to first convert it into gas, it is interesting to note that in the gasification of fuels having a high percentage of moisture, high percentages of carbonic acid and hydrogen occur in the gas. This is probably due to the fact that at a temperature of about 1100° F., water vapor oxidizes carbonic oxide to carbonic acid. Therefore, coke and charcoal, which have a low value as a direct-firing fuel, work more favorably in a gas producer, and yield more gas per pound than any other material. The approximate yield of gas per pound of different materials is as follows: coke or charcoal, 104 cubic feet; anthracite, 85 cubic feet; bituminous coal, 75 cubic feet; lignite or brown coal, 55 cubic feet; peat, 45 cubic feet; wood 35 cubic feet.

Tests on Fuel.— The most important conclusions of the tests on fuel made by the government and by the laboratories of some of the principal universities are as follows:

1. Samples of coal from 17 States, tested in steam boiler plants, indicate that the high steaming quality of many of the American coals may be improved by washing.
2. Most of the American coals and lignites constitute an available source of power by utilization in gas producer plants.
3. Comparative tests made by the government on 14 bituminous coals from nine States, indicate that when these coals are used in a gas producer plant, their power efficiency is two and one-half times greater than when they are directly fired in a steam boiler plant.
4. Some of the lignites found in undeveloped but extensive deposits in the Dakotas and Texas, show very high power producing qualities when gasified in the gas producer and used in the gas engine.
5. Some of the American coals, and the stock produced in mining them can be briquetted on a commercial basis.
6. Under these conditions of attainable fuel economy, it is merely a question of time when the gas engine will supersede any possible type of steam motor.

For relevant information consult articles under the title GAS; GAS ENGINE; GASES, LAWS OF; and GAS PRODUCER.

Bibliography.— Bjorling, P. R., 'Briquettes and Patent Fuel' (New York 1909); Booth, W. H., 'Liquid Fuel and Its Combustion' (Westminster 1903); Brame, J. S. S., 'Fuel: Solid, Liquid and Gaseous' (New York 1914); Brislese, F. J., 'An Introduction to the Study of Fuel' (New York 1912); Coste, I. H., and Andrews, E. R., 'Fuel, Gaseous, Liquid and Solid' (London 1914); Lewes, V. B., 'Liquid and Gaseous Fuels' (London 1907); Poole, H., 'The Calorific Power of Fuels' (New York 1907); White, A. H., 'Technical Gas and Fuel Analysis' (New York 1913); United States Bureau of Mines Bulletin 23, 'Steaming Tests of Coal' (Washington 1908).

FUELS. See INTERNAL COMBUSTION ENGINE.

FUELS FOR LOCOMOTIVES, Comparative Value of. See LOCOMOTIVE.

FUENTEOVEJUNA, foo-en"tā-ō-vē'hoo-na, Spain, town in the province of Cordóba, 45 miles northwest of the city of the same name. It is an important agricultural centre and has manufactures of bricks, flour, leather, soap, etc. Lead, calcite and building stone are obtained in the neighborhood. The town has a considerable trade, in wine, fruit and ordinary agricultural produce. It is famed for its honey and by many is believed to be the ancient Mellaria of the Romans. Pop. 13,470.

FUENTERRABIA, foo-en"-ter-rä'bē-ạ, Spain, town in the province of Guipúzcoa, on the French frontier and on the Bidassoa River. It has a mediæval aspect but in recent years a new town for summer visitors has sprung up without the walls of the old. The town has an ancient castle, a town hall, and is noted for its old gabled houses. Its principal industries are the manufacture of rope, nets, flour, lumber and paper. It had the usual fortune of a frontier town in the Middle Ages, being repeatedly attacked and sacked. Pop. 4,976.

FUENTES DE OÑORO, foo-en-tes dẹ ôn-yō'rō, Spain, village on the Portuguese border, 15 miles west of Ciudad Rodrigo. On 3 May 1811, it was the scene of a sharp engagement between the English forces of Wellington and the French under Masséna and Bessières. The French were debarred from their project of invading Portugal. Pop. 1,200.

FUERO, foo-ār'ō, **Joaquin**, Mexican soldier: b. Guadalupe Hidalgo, 1814; d. 1867. He received his education at the Military School of Segovia and became professor and vice-president of that institution. He suppressed the insurrection of 1840 and three years later was made chief of staff of the Tamaulipas army division. He fought against the Americans in 1846–47 and was seriously wounded in one engagement. He wrote 'Manual del militar, ò tratado completo de instrucción en la ordenanza' (1842), and a translation of McKenna, 'Military Tactics.'

FUERO (from the Latin *forum*), a Spanish word signifying jurisdiction, law, privilege. It is applied to the various written codes and characters of particular districts, towns, etc., and signifies generally those laws, privileges and immunities founded on usage and sanctioned by the suzerain or supreme authority. Fueros are both civil and ecclesiastical. The earliest, as well as the most universal, is the *fuero juzgo*. This name (a corruption of the Latin *forum judicum*) is given to a 13th century translation of a code of the 17th century. It contains the Gothic laws which, up till this time, gradually superseded the Roman. Each law receives the name of the Gothic sovereign by whom it was promulgated. This code has formed the foundation of Spanish law down even to modern times. The fueros of Leon, known by the name of *fueros bonos*, contain a complete constitution, civil and ecclesiastical, recognize the rights of self-taxation, and of the nobility of all subjects by birth. The constitution of free towns under these fueros is essentially republican, the king having only a right to name the corregidor, who must be confirmed by the junta of the province, an assembly elected by a very liberal suffrage. As the various monarchies became consolidated under a single head, the kings became anxious to evade or withdraw privileges which interfered with the organization of their kingdom, and after 1592 when Philip II entered Aragon with an army, hanged the grand-justiciary, whose office it was to administer the oath, and abolished the constitution, the fueros as a political institution ceased to exist, although some local and municipal privileges continued to be called by that name. In 1833 a civil war broke out in the Basque provinces, in assertion of the fueros, which were formally recognized in 1844. In 1876, however, the fueros of these northern provinces were superseded by the general laws of the kingdom. Consult Arias, M., 'Fueros observancias, actosde Cortes de Aragon' (Saragossa 1907); San Martin, ed. 'Los códigas españoles' (Madrid 1872–73).

FUERTE VENTURA, fwär'tä vĕn-too'rä, one of the Canary Islands, belonging to Spain. It is situated between the Grand Canary and Lanzarote. In general the soil is not productive and the rainfall is slight. Fishing and the raising of goats are the principal industries. Among the products of the island are figs, olives, almonds, gypsum and chalk. It has an area of 650 square miles and numerous extinct volcanoes. Its principal harbor is Cabras on the east coast. Pop. about 13,000. See CANARY ISLANDS.

FUERTES, Estevan Antonio, American civil engineer: b. San Juan, Porto Rico, 1838; d. 1903. He received his education at Salamanca, Spain, and at the Rensselaer Polytechnic Institute, Troy, N. Y. In 1861–63 he was assistant engineer in the Department of Public Works, Porto Rico, and subsequently served as director of public works for the western district of that island. Coming to the United States in 1864 he was successively assistant engineer and engineer to the Croton Aqueduct Board, and in 1870–71 was chief engineer of the American Isthmian Canal expeditions to Tehuantepec and Nicaragua to investigate and report on the practicability of a ship canal connecting the Caribbean and the Pacific. In 1873 he was appointed dean of the civil engineering department of Cornell, and in 1890–1902 directed the college of civil engineering there and brought the equipment of that department up to modern standard. In 1902 he became professor of astronomy at Cornell and supervised the construction of the Barnes Observatory. He planned a drainage system for Santos, Brazil. He was a member of many scientific societies, American and foreign.

FUERTES, foo-är'tęs, **James Hillhouse,** American civil and sanitary engineer: b. Ponce, Porto Rico, 10 Aug. 1863. He was graduated from Cornell University in 1883. He has constructed works for the sewerage, drainage and water supply of various cities in the United States, Canada and Brazil, and served as consulting engineer of various corporations and municipalities, and is a non-resident lecturer at Cornell. He has published 'Water and Public Health' (1897); 'Water Filtration Works' (1901); 'European Sanitary Engineering Series' in the *Engineering Record*, and numerous monographs on engineering and sanitary subjects, etc.

FUERTES, Louis Agassiz, American painter of birds: b. Ithaca, N. Y., 7 Feb. 1874. He was graduated from Cornell University in 1897. His habitat bird groups in the American Museum of Natural History are one of the most attractive features of the institution. He made 25 decorative panels for F. F. Brewster of New Haven, Conn. He has illustrated 'Birding on a Broncho' (1896); 'Citizen Bird' (1897); 'Song Birds and Water Fowl' (1897); 'Bird Craft' (1897); 'The Woodpeckers' (1901); 'Second Book of Birds' (1901); 'Birds of the Rockies' (1902); 'Handbook of Birds of Western North America' (1902); 'Coues' Key to North American Birds'; the plates for the 'Report' of the New York State Game, Forest and Fish Commission (1903); 'Upland Game Birds' (1902), and the companion volume, 'Waterfowl' (1903); New York State Museum, Eaton's 'Birds of New York' (1909–14); 'Handbook of Birds of Eastern North America' (1912), and much illustration for current magazines of ornithology, governmental reports, and many paintings privately owned. etc.

FUGA, Ferdinando, Italian architect: b. Florence 1699; d. 1784. He spent most of his active life in Rome, where there are many examples of his work, including the Corsini Palace, and the exterior of the Church of Santa Maria Maggiore. He removed to Palermo toward the end of his life and died there while employed in the reconstruction of the cathedral of that city.

FUGER, Heinrich, German artist: b. Heilbronn, Würtemberg, 1751; d. 1818. At Stuttgart he studied under Guibal and under Oeser at Leipzig. He toured Italy and studied brief periods at Rome and Naples. He was made court painter at Vienna, was appointed professor and assistant director at the Academy of that city, and became director of the Belvedere in 1806. His best works are the portraits of Joseph II, the Grand Duchess Elizabeth, Queen Caroline and Nelson (in the National Gallery, London), and the historical paintings 'Farewell of Coriolanus,' 'Allegory of Peace,' 'Bathsheba' and other examples in the Vienna collections.

FUGGER, fook'ĕr, or fug'ger, the name of a wealthy and illustrious German family of Suabia, descended from a weaver, who originally lived in the environs of Augsburg, about 1300. They were at first successful in selling clothes, but afterward extended their dealings and became merchants, accumulating an immense fortune. Reaching the height of their affluence at the commencement of the 16th century, they rendered considerable services to the Emperors Charles V and Maximilian, by making them large advances. These princes bestowed titles of nobility on the Fugger family, and they soon became connected with the best blood of Germany. Promoted to the highest dignities of the empire, they did not any the more neglect the pursuits of commerce. Their riches were always forthcoming for the improvement of their birthplace, Augsburg, where they erected some handsome monuments and founded philanthropical institutions. The best known of them are the three brothers, Ulric, James and George; and afterward Raymond and Antony, both sons of George. Ulric received for his loans to Maximilian the courtship of Kirchberg, and the seigniory of Weissenhorn, which afterward remained in the possession of his family. He was a great encourager of learning. Antony and Raymond bore, to a great extent, the expenses of the expedition of Charles V against Algeria, obtaining from him the permission to coin money. One day, at an interview with the emperor, Antony, as a mark of his regard and esteem, threw into the fire all the title-deeds and securities which Charles had deposited with him. Toward the close of the 18th century the family withdrew altogether from trade, confining themselves to the management of their landed estates. Count Anselm Maria of Babenhausen, of the Wellenberg line (b. 1776; d. 1821), was raised by the Emperor Francis II to the dignity of a prince of the empire. The principality of Babenhausen was annexed to Bavaria in 1806, and Leopold Fugger Babenhausen (1827–85), grandson of the first prince, was a hereditary Imperial councilor, and lord high-chancellor of Bavaria. He was succeeded by his brother Karl Ludwig Maria Fugger (b. 1829), who in 1891–93 was president of the Bavarian Reichsrat. Consult Jansen, 'Studien zur Fugger-geschichte' (Leipzig 1907), and Stauber, 'Das Haus Fugger von seinen Antängen bis zur Gegenwart' (Augsburg 1900).

FUGGERS Bank of the. The foundation of this great banking house was laid in Augsburg, Bavaria, about the middle of the 15th century. (Rabelais, 'Letters from Rome,' 1536). As its active career extended to the middle of the 17th century it embraced a period of some 200 years during which interval it was accounted the richest banking house in northern Europe, commercially the most extensive and politically the most important in its financial operations. The fortunes of the Fugger family grew originally out of the woolens trade, in which a great rivalry arose between the growers and merchants of wool in England, Germany and Spain, and the dyers and finishers of Italy. The political importance of the Fuggers coincided with the reign of Charles V, whose youth, 1500–1516, was passed in Ghent (Flanders), where he was born. The expenditures of the young prince exceeding his income, he had recourse for assistance to the Fuggers of Augsburg, one of whom (probably Antony), resided and conducted an agency of the house in Flanders. In 1548, after Charles had successively ascended the thrones of Spain and Germany, he reformed the government of Augsburg, marking the occasion by elevating the Fuggers to the dignity of senators and conferring the title of baron upon Raymond and Anthony. In the European wars which engaged the emperor, as well in the administration of his affairs in Spain and America, the Fuggers often shared his confidence and frequently responded to his demands for financial assistance. Among the minor, though now most interesting of the projects which were undertaken in the earlier portion of the great emperor's career one which was financed by the Fuggers, was a survey by Flemish engineers of the Isthmus of Darien, with a view to the construction of a Panama Canal, about 1526 (Rev. Peter Heylin's 'Microcosmos,' 1631, p. 788), a design whose grandeur had yet to await for its fulfilment another 400 years. The bank of the Fuggers, with agencies in the principal cities of Europe, was a depository for the funds of numerous commercial houses and trading companies, whose paper it discounted and whose plans it often promoted. It issued and cashed bills of exchange, bought coins and bullion, and advanced money upon bills of lading and consignments of merchandise; it even acquired the extraordinary privilege, in at least three places, of minting its own coins, some specimens of which are preserved in the great continental cabinets. Consult Hazlitt, 'European Coinage; mints of Augsburg, Fugger and Weissenhorn.' For the history of other ancient European banks see BARCELONA, BANK OF; BYZANTIUM, BANK OF; GENOA, BANK OF; MEDICI, BANK OF THE; TYRE, BANK OF; VENICE, BANK OF.

ALEXANDER DEL MAR.

FUGIO. See CENT.

FUGITIVE, *in law,* is a term applied to persons who having violated the laws of a State escape into a foreign territory. As one State cannot pursue criminals into the territories of another, the practice prevails among the more enlightened nations of mutually surrendering such fugitives to the justice of the injured State. This practice is founded on national comity and convenience, or on express compact. The United States recognize the obligation only when it is created by express agreements. (See EXTRADITION). As between the States of the American Union, extradition is made compulsory by the Federal Constitution, Article IV, Section 2, which provides that "a person charged in any State with treason, felony or other crime, who shall flee from justice and be found in another State, shall, on demand of the executive authority of the State from which he fled, be delivered up, to be removed to the State having jurisdiction of the crime." In the several States there are statutory provisions or established usages regulating the procedure in such cases.

FUGITIVE-SLAVE LAWS. In the colonies and under the Confederation, fugitive slaves could be reclaimed only through intercolonial or interstate comity, and in framing the Constitution, one of the chief inducements for the South to join was a fugitive-slave clause. The mandate to deliver them up, however, was only to the States, which could not be punished for refusing to comply; and as the free States recognized no obligation of comity on this point, the general government passed the first fugitive-slave law, signed by Washington, 12 Feb. 1793. The oral testimony of the alleged owner was all the evidence required, and on this any magistrate, even a town justice, was ordered to surrender the alleged fugitive; $500 fine was imposed for rescue, concealment or obstruction of arrest. This made kidnapping free blacks a pastime, and it was extensively carried on in the Border States; motions to amend the law and require more evidence were voted down. On the other hand, the

Border States complained of increasing escapes, and Congress promptly passed an amendment (30 Jan. 1818), enabling a claimant to make his proof before a judge of his own State and abolishing the habeas corpus in such cases. The Northern magistrates, however, revolted against the obligation; Pennsylvania passed a law contravening the national act and providing its own methods of reclamation, and made them incumbent on her own magistrates; a Maryland slave-seeker thereupon carried off an alleged slave by force, and on his indictment the Supreme Court decided (Prigg v. Pennsylvania) that the execution of Federal laws could not be imposed on State officials. Taney dissented; and on this doubt the Northern States began to pass «personal-liberty laws» to prevent their officials being so employed or their buildings used as places of detention. With the spread of anti-slavery sentiment there also sprang up a method of assisting runaway slaves by sending them under cover of night from one sympathizer to another. This was called «the underground railway.» The South became roused to demand an effective fugitive-slave law as the price of remaining in the Union; and that of 1850 (see COMPROMISE OF 1850), the death-knell of the Northern-Southern Whig party, was passed, placing the whole course of reclamation in Federal hands. The entire machinery of the United States, from courts to army, was made part of a grand system for this one purpose, and new officials were appointed for it; marshals were liable to $1,000 fine, plus the value of the slave, if he escaped or even was forciblv rescued, and bystanders were held guilty of treason for refusing to assist; the owner's oath was full evidence, that of the alleged fugitive was not to be received, and the habeas corpus was rendered null; obstruction, rescue or concealment was punishable by six months' imprisonment and $2,000 damages and fine; if the claimant «apprehended» a rescue, the marshal was to take the fugitive to the claimant's State himself before surrendering him; lastly, an affidavit and general description made in the claimant's own State was to be valid for a reclamation in any other. This atrocious act was met by more stringent personal-liberty laws, which made it hard for the alleged owner or his United States agents to find any State soil to stand on in executing the writs or holding the fugitive; and in 1859 Wisconsin openly threatened to secede if the mandates were executed on her soil. Its political result was an undreamed-of boomerang, each seizure rousing a storm of indignation, often inflamed still more by the incidents — as riot and bloodshed, the murder of her child by a mother to save it from slavery (see GARNER CASE), the prosecution for treason of two Quakers who refused to join the hunt (see CHRISTIANA CASE), the seizure of long-time free black citizens of towns, etc. The Free-Soil party demanded its repeal; the Republican party inherited and pressed the claim; the success of the latter in 1860 was taken by the South as notice that the next administration would repeal it, and was a leading cause of the secession of 1861; and in the sequel the obnoxious law was repealed in 1864. Consult McDougall, M. G., 'Fugitive Slaves' (1891); Siebert, W. H., 'The Underground Railway' (1898); Smith, T. H., 'Parties and Slavery' (1906). See also UNITED STATES, SLAVERY IN THE; UNDERGROUND RAILWAY.

FUGIWARA, a noble family of Japan, eminent in civil affairs. It was founded by Kamatari, regent of the empire, in 645–49 A.D. It has given many statesmen, historians, scholars, poets, artists, etc., to Japan and was long the most powerful family in the empire. The empress of Japan is of this family, being of the 40th generation in descent from Kamatari. Consult Mentchikov, 'Empire du Japon' (Geneva 1881).

FUGUE, füg, a musical term derived from the Latin word *fuga*,— a flight, and signifying a polyphonic composition constructed on one or more short subjects or themes, which are harmonized according to the laws of counterpoint (q.v.), and introduced from time to time with various contrapuntal devices. The interest in these frequently heard themes is sustained by diminishing the interval of time at which they follow each other, and monotony is avoided by the occasional use of episodes, or passages open to free treatment. The chief elements of a fugue are: (1) the subject; (2) the counter-subject, or contrapuntal harmonization of the answer by the part which has finished the enunciation of the subject; (3) the answer; (4) episodes; (5) the stretto; and (6) the pedal point. There are three kinds of fugue, the simple, containing one subject; the double, consisting of two subjects, occasionally intermingled and moving together, and the counter fugue, in which the subjects move in a direction contrary to each other. In all fugues the parts *fly*, as it were, after each other, whence the name. The great masters of fugal form are Johann Sebastian Bach and Handel.

FUHCHOW. See FOOCHOW.

FÜHRICH, Joseph von, Austrian painter and engraver: b. Kratzau, Bohemia, 9 Feb. 1800; d. Vienna, 12 March 1876. He studied at Prague under Bergler and in 1824 designed plates for Tieck's 'Genovera.' In 1827 he removed to Rome, there joined the German Nazarenes, and collaborated in the fresco work of the Villa Massimi. He returned to Prague in 1829, went to Vienna five years later, and in 1841 received the appointment of professor at the Academy there. He painted a series of frescoes in the Church of Saint John Nepomucene in 1844–46, and a large fresco in the Altlerchenfeld in 1854–61. For the latter he was ennobled and made a member of the order of the Iron Crown. His paintings include 'The Mourning Jews' (Prague); 'Christ going to the Mount of Olives'; 'Peter's Draught of Fishes'; and 'Mary's Journey over the Mountain' (in the Vienna gallery). His best engravings are series illustrating the Psalter, the Imitation of Christ, and the Prodigal Son. Consult Muther, 'History of Modern Painting' (London 1907) and Wörndle, 'Joseph Führichs Werke' (Vienna 1914).

FUJI-NO-YAMA. See FUJIYAMA.

FUJI-SAN. See FUJIYAMA.

FUJITA, foo-zhē'tä, **Sadusake** (real name, HONDA TEIKEN), Japanese mathematician: b. 1734; d. 1807. He was a native of the Province of Mushashi and attained eminence in his chosen field, being the leading Japanese mathematician of his century. He wrote the celebrated 'Seiyo Sampo' (1779), mostly devoted to algebra, and many other works.

FUJIYAMA, FUJI-NO-YAMA, or FUJI-SAN, the sacred mountain of Japan, situated in the Province of Suruga, 60 miles west of Tokio, and having an elevation of 12,395 feet. It is a volcano, having a crater 2½ miles in circumference and 500 feet in depth. The last eruption took place in November 1707–January 1708. Many pilgrims visit it annually from all parts of the empire and on its sides are numerous shrines and temples. Consult Griffis, 'The Mikado's Empire' (11th ed., 2 vols., New York 1906) and Satow and Hawes 'Handbook for Travelers in Central and Northern Japan' (Yokohama 1881).

FUKIEN, or FOKIEN, China, a maritime province of the republic, bounded north by Chekiang, west and northwest by Kiangsi, south by Kuangtung and east by Formosa Channel. It has an area of 46,300 square miles and a population of 22,000,000. The surface is broken by low mountain ranges running from southwest to northeast and having densely wooded slopes. The soil is very fertile and is under intensive cultivation. Wheat, barley, rice, tea, sugar and indigo are produced in large quantities. Timber cutting is an important industry but manufacturing is at a low ebb. Porcelain of great value is produced and has long been unexcelled in quality. Foochow and Amay are the treaty ports of the province. See CHINA.

FUKUDA, Tokuso, Japanese educator: b. Tokio, 2 Dec. 1874. He was graduated at the Higher Commercial School of Tokio in 1894, afterward went abroad and studied economics and the history of political economy at Leipzig University. Subsequently he studied at the University of Munich and also at Paris and Genoa. Upon his return home in 1901 he was appointed professor at the Higher Commercial School, in 1906 he removed to the University of Tokio and subsequently was appointed professor at Keio University. He has published 'National Economy' and 'Labor and Economy.'

FUKUI, Japan, capital of the province of Echizen, on the Ashiwa River, five miles from its mouth. It is well built and is noted for its cleanliness. It has a long and honorable history and is a great Buddhist centre. There are also many Christian missions. The city manufactures annually about $10,000,000 worth of a white silk known as habutai. There are many smaller places of this name throughout the empire. Consult Griffin, 'The Japanese Nation in Evolution' (New York 1911). Pop. 53,000.

FUKUOKA, Japan, a prefectural town, 150 miles from Kokura, on the northern coast of Kiushiu. It contains an ancient castle, a public garden and has many splendid streets. There is also a permanent garrison stationed at the castle. Pop. 97,303.

FUKUSHIMA, Japan, town in the province of Iwashiro, 170 miles from Tokio and 50 from Sendai. It is the seat of a prefect and has a large trade in cocoons and raw silk. Pop. 33,500.

FUKUYAMA, Japan, seaport situated at the southern end of the Island of Yezo, 60 miles from Hakodate. Before the abolition of feudalism it was of great commercial importance, being the main outlet for the products of the entire island. In modern times Hakodate has usurped its place in the commercial world. The city has numerous temples and many remains of its former splendor. Pop. 15,000.

FUKUZAWA, Yukichi, foo-koo-zah-wah you-keé-chi, Japanese educator and author: b. Buzen, 1834; d. 1901. In the last generation, he was the intellectual father of one-half of the young men in civil government service in Japan, and the teacher of a large number of those who to-day direct the affairs of the empire. He mastered early the Dutch language and later the English. After traveling with the Japanese Embassy in America in 1860, on his return he refused all offers of honor or emolument under the government and devoted himself to education, authorship and journalism in championship of western civilization, especially in its American form. His books, 50 or more, treating of what were then novel themes, reached a sale of 4,000,000 copies. He founded the Keio University which has continued in wholesome rivalry with the Imperial University. No other individual did so much by pen and voice to mold the mind of the nation in favor of Occidental civilization. His two sons were educated at Yale University. Consult Chamberlain, 'Things Japanese' (1890); Morris, 'Makers of Japan' (1906).

FULAH, a Hamite-Negro people dwelling on the upper Senegal and from Senegambia to Darfur. They resemble the Berber peoples of North Africa, are negroid in speech and frizzled hair. Their color is light brown or copper and they are of good stature. They are divided into four great branches: The *Baa*, the *Jel*, the *Beri* and the *So*, these in turn are subdivided into many tribes. Consult Meyer, Hans, 'Das deutsche Kolonialreich' (Vol. I, Leipzig 1909).

FULBERT, French bishop and writer: b. about 960; d. 1028. At the Rheims school conducted by Gerbert, Fulbert was a charity student. Later he became connected with the diocese of Chartres. He became a teacher at Chartres and under his direction the academy there became renowned as a seat of learning. He was made bishop of Chartres in 1006, rebuilt the cathedral during his episcopate and took an active part in the political world of his day. He wrote letters, hymns and discourses; the first-named are useful as a history of his period. His literary remains are to be found in Migne, 'Patrologia Latina' (Vol. CXLI). Consult Pfister, 'De Fulberti Carnotensis Episcopi Vita et Operibus' (Nancy 1886).

FULDA, fol'da, **Ludwig,** German dramatist: b. Frankfort, 15 July 1862, of Jewish ancestry. After finishing the schools of his native city, he attended several German universities, finally taking the degree Doctor of Philosophy, from the University of Heidelberg in 1883. He had devoted himself largely to German literature and presented a thesis on Christian Weise, a German dramatist of the 17th century. From 1884 to 1888 he lived in Munich where he came in touch with Paul Heyse to whom he is indebted for help in striving for grace of form and perfection of finish. Since 1888 he has lived in Berlin. Here he came under the influence of the naturalistic movement. This affected him only temporarily, however, as he was not of a serious turn of mind and soon he gave most of his time to satire and light comedy. In 1906 and in 1913–14 he made lecture tours in the United States. Upon returning home from his first trip he published a volume entitled 'Amerikanische Eindrücke' which records in a rather easy superficial manner his impressions of America.

After beginning his literary career Fulda produced a succession of plays, most of which gained a fair degree of popularity upon the stage. He understands dramatic technique and his plays as a rule act well. They are bright, witty and sparkling in dialogue, though they lack originality and are not profound. They are amusing, but have no seriousness of purpose. It has been argued that his plays belong to the history of the theatre rather than to the history of literature. His dramas may be divided into three classes: Comedies, serious social plays and allegorical and symbolistic dramas. Examples under the first head are 'Unter vier Augen' (1886), and 'Der Dummkopf' (1907) which is perhaps his best stage play. Of his serious social plays 'Das Verlorene Paradies' (1890), 'Die Sklavin' (1891) and 'Maskerade' (1905) are the most important. Of his symbolistic dramas 'Der Talisman' (1893) and 'Der Sohn des Kalifen' (1896) are best known. The latter is by some considered his best play. But Fulda's enduring fame will probably rest upon his translations from the French of Molière, Beaumarchais and Rostand (Cyrano de Bergerac 1898). In recognition of the superior character of this work the French government bestowed on him the Legion of Honor in 1907. (See LOST PARADISE, THE). Consult Meyer, R. M., 'Die deutsche Literatur des Neunzehnten Jahrhunderts.'

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FULDA, Prussia, the capital of a district in the province of Hesse-Nassau, on the river Fulda, 70 miles northeast of Frankfort. Its cathedral is a replica on a lesser scale of Saint Peter's, Rome, and contains the remains of Saint Boniface. It contains also the 9th century church of Saint Michael, the old episcopal palace, a Benedictine convent, and large barracks, a Catholic gymnasium, with a library of 40,000 volumes, a teacher's training school and a school of military music. It has a large cattle market and manufactures textiles, leather, metal goods, agricultural implements, chemicals, soap, vinegar, etc. It was once the seat of a university and was ceded to Prussia in 1866. Pop. 22,500.

FULDA, Abbey of. A Benedictine abbey in Prussia, which is also the seat of a bishopric. The abbey was founded in 744 under the direction of Saint Boniface, who made it an episcopal see as a part of his plan for evangelizing Germany. The rule of the community was modeled on that of Monte Cassino, and absolute autonomy was secured to it by Pope Zachary in 751. The authenticity of the document granting this privilege has been questioned, but it is now generally accepted as genuine. The monks at Fulda devoted themselves particularly to the development of agriculture, and established many smaller monasteries in Thuringia, Saxony, Hesse, Bavaria, Lorraine, Swabia and other parts of Germany, these subordinate houses becoming centres of thriving agricultural communities. Art and literature were also assiduously cultivated at Fulda. A splendid church, erected in the 9th century on the site of the original structure, was famous throughout Europe, and exercised for centuries an influence on ecclesiastical architecture. The monastic school, established by Saint Sturmius, the first abbot, began to flourish during the time of Charlemagne, and became celebrated throughout Europe. Abbot Rabanus Maurus (822–42) assembled a great library, which was further enriched during the following centuries by the labors of the monks. By the end of the 10th century the abbey had achieved a very important position in the German Empire. From 968 the abbot was primate of all the Benedictine abbeys in Germany and Gaul, and from the 12th century, he was a prince of the empire. The abbey grew so rich in lands, tithes and other sources of revenue that the monastic discipline was much relaxed. The importance of the school declined perceptibly. At a comparatively early date the teachings of the Reformation affected the chapter, but late in the 16th century discipline was re-established and the Catholic faith restored. The foundation of a Jesuit college there in 1571 revived the scholastic spirit, which had almost ceased to exist. In 1584 a papal seminary was established and also placed under the direction of the Jesuits. During the Thirty Years' War the abbey suffered, but afterward it enjoyed a period of peace and prosperity, and in 1732 the Jesuit and the Benedictine schools were united and converted into a university. In 1802 the abbey, which then embraced a territory of about 40 square miles, with a population of 100,000, was secularized. In 1809, under Napoleon it was ceded to the Grand Duchy of Frankfort; in 1815 to Hesse-Cassel, with which it passed in 1866 to Prussia. The university was closed under the law of secularization, and the papal seminary was converted into an episcopal seminary.

THOMAS GAFFNEY TAAFFE.

FULFORD, Francis, Canadian bishop: b. Sidmouth, England, 30 June 1803; d. 9 Sept. 1868. He was a graduate of Exeter College, Oxford; was ordained to the priesthood in 1826; consecrated first Anglican bishop of Montreal, 25 July 1850 and elected metropolitan 1860.

FULGENTIUS, Fabius Planciades, African grammarian: b. about 480; d. about 550 A.D. Of his life we know nothing beyond what may be gleaned from internal evidence. He wrote 'Liber de Ficticiis Poetarum'; 'Liber Physiologus'; 'Mythologicon Libri III'; 'Expositio Vergilianæ Continentiæ'; 'Absque Literis, de Ætatibus Mundi' and 'Expositio Sermonum Antiquorum.' Consult the Teubner text 'Fulgentii Opera' (1898) and Zink, 'Der Mytholog Fulgentius' (Würzburg 1867).

FULGENTIUS, Saint, Bishop of Ruspe: b. Telepte, North Africa, 468; d. 533. He was of senatorial rank by birth, was well educated and became procurator of the province. The wars and troubles of the period caused him to seek refuge in a monastery near Telepte. Being persecuted by the Arian rulers, the monks were driven out and Fulgentius went to Rome in the year 500. He returned to Africa, founded a monastery and in 508 became bishop of Ruspe.

Two years later he was banished and again in 515. He suffered other indignities at the hands of the vandal king Thrasimund. On the latter's death in 523 Fulgentius returned to his see and spent his remaining years in peace. He was a rigorous ascetic and a champion of monasticism. He is honored on 1 January in the Catholic Church. Consult Migne, 'Patrologia Latina' (Vols. LXV and LXVII); Bordenhewer, 'Patrology' (Saint Louis 1908); and Mally, 'Das Leben des heiligen Fulgentius' (Vienna 1885).

FULGURITE. On mountain summits, it has been noticed occasionally that the surface of the rock shows in places a glassy film, and that fine depressions may be present, or small droplets of vitrified rock. It has been reasonably inferred that these are due to the fusion of the rock materials by lightning. On sand hills in many places curious natural tubes have been found projecting above the surface, and these, when examined under the microscope, are found to consist of a thin film of glass enclosing sand grains. They descend through the sand to depths of several feet, often branching in their course. These also are the product of lightning and are also known as fulgurites.

FULHAM, England, a metropolitan and parliamentary borough of London, six miles south of Saint Paul's opposite Putney. Area, 1,703 acres. It contains the residental districts of West Kensington and Walham Green. Here is the palace or manor house of the bishop of London, surrounded by a moat. The oldest part of the building dates from the beginning of the 16th century. The parish church of Saint Ann's contains some fine monuments preserved from the older building. The Queen's Club grounds are celebrated for their athletic meetings. The borough returns one member to Parliament. Pop. 153,284. Consult Feret, 'Fulham, Old and New' (1900).

FULKE, William, English Puritan: b. London 1538; d. 1589. He was educated at the University of Cambridge, began his studies for the bar, but soon abandoned this field for that of theology. In 1564 he was made a Fellow of Saint John's College and five years later rector of Warley and Dennington. In 1578 he became master of Pembroke Hall. He was an ardent Puritan of the extremist type and took an ungodly delight in the religious squabbles of his time. He wrote 'Defense of the Sincere and True Translation of the Holie Scriptures into the English Tong against the Cavils of Gregory Martin' (1583); 'Stapleton's Fortress Overthrown' (1580); 'Rejoinder to Marshall's Reply against the Answer of Martin Calfhill' (1580); 'Discovery of the Dangerous Rock of the Popish Church' (1582). An edition of these works appeared at Cambridge (1843–48).

FULLAM, William Freeland, American naval officer: b. Monroe County, N. Y., 20 Oct. 1855. In 1877 he was graduated at the United States Naval Academy at the head of his class; attained the rank of commander in 1905, and that of captain in 1909. In 1883–1904 he was engaged as instructor at the Naval Academy, in various departments, and lastly as chief of the department of ordnance. In the Spanish-American War he served on the *New Orleans*. In 1907–09 he was commandant of the training station at Newport, R. I., and commanded the *Mississippi* in 1910. Two years later he had charge of naval training on the Great Lakes, and in 1914 became superintendent of the United States Naval Academy. In 1915 he became commander of the Pacific Reserve fleet. He published 'Handbook of Infantry and Artillery, United States Navy' (1899); 'Textbook of Ordnance and Gunnery' (new ed., 1905); and 'The Recruits' Handy Book.'

FULLER, Andrew, an English Baptist clergyman and theologian: b. Wicken, Cambridgeshire, 6 Feb. 1754; d. Kettering, 7 May 1815. He was largely self-educated. He began preaching in 1774 and the next year became pastor at Soham. In 1782 he removed to Kettering where he labored for the rest of his life. Out of his «Monthly Concert,» a meeting for prayer for the conversion of the world, came the Baptist Missionary Society which sent forth William Carey. Mr. Fuller was secretary of the Society from its beginning until his death. He was the author of several theological works. The principal ones are 'The Catholic and Socinian Systems Compared' (1793); 'The Gospel: Its Own Witness' (1800); 'Strictures on Sandemanianism' (1809); 'Letters on Communion' (1815). His works were published in 5 vols., London 1831, and a more complete edition in 3 vols., Philadelphia.

FULLER, Arthur Buckminster, American Unitarian clergyman: b. Cambridgeport, Mass., 1822; d. at the battle of Fredericksburg, Va., 13 Dec. 1862. He was graduated from Harvard in 1843, studied in the Harvard Divinity School, and held pastorates in Manchester, N. H., and Boston and Watertown, Mass. In the Civil War he was chaplain to a Massachusetts regiment. He edited several works of his sister, Sarah Margaret Fuller (q.v.). Consult Fuller, R. F., 'Chaplain Fuller' (Boston 1863) and Higginson (in 'Harvard Memorial Biographies,' Vol. I, Cambridge, Mass., 1866).

FULLER, George, American artist: b. Deerfield, Mass., 1822; d. Brookline, Mass., 21 March 1884. He went to Illinois in 1836, and, having developed a taste for painting, studied in 1842 under Henry Kirke Brown, at Albany, N. Y. After working in Boston for a few years, he went to New York, where in 1857 his portrait of his former teacher, Mr. Brown, the first of his works to attract notice, gained him an election as associate of the National Academy. He spent eight months in European study and travel in 1859 and then retired to his farm at Deerfield, using his art only for recreation, till financial reverses in 1873 forced him to take it up again as a profession. About 1876 his pictures began to be noticed for their peculiar handling, richness of tone and a dreaminess of conception which, when admired at all, was admired very thoroughly. A memorial exhibition of his works was held at the Boston Museum of the Fine Arts in 1884. His contributions to the National Academy exhibitions include 'The Turkey-Pasture, Kentucky' (1878); 'The Dandelion Girl'; 'The Romany Girl' (1879); 'The Quadroon' (1880). To the exhibitions of the Society of American Artists he sent 'Priscilla Fauntleroy' (1882); 'Nydia' (1883). Other works of his are 'Cupid' (1854); 'Negro Nurse, with a Child' (1861); 'At the Bars' (1865); Shearing the Donkey' (1879); 'And She was a Witch'

(1879); 'The Gatherer of Simples' (1880); 'Winifred Dysart' (1881); 'Psyche' (1882); 'November' (1884); 'Fedalma' (1884); 'Arethusa' (1884) and numerous portraits. He left an unfinished picture representing a trial for witchcraft in the early days of New England. Consult Isham, 'History of American Painting' (New York 1905) and the biography by Millet (Boston 1886).

FULLER, Henry Blake, American author: b. Chicago, Ill., 9 Jan. 1857. He entered literature with 'The Chevalier of Pensieri-Vani' (1891), and 'The Châtelaine of La Trinité' (1892). He next wrote 'The Cliff-Dwellers' (1893), and 'With the Procession' (1895), novels of Chicago life; 'The Puppet-Booth' (1896), dramatic sketches; 'From the Other Side' (1898), short stories; 'The Last Refuge' (1900); 'Under the Skylights' (1901); 'Waldo Trench and Others' (1908).

FULLER, Lucia Fairchild, American artist: b. Boston, 6 Dec. 1872. She was educated at Shaw's Private School, the Cowles Art School under Dennis M. Bunker, and at the Art Students' League, New York, under William M. Chase and H. Siddons Mowbray. Since 1889 she has been engaged professionally as a painter, chiefly of miniatures. She was married in 1893 to Henry Brown Fuller. She was awarded a bronze medal at the Paris Exposition of 1900, a silver medal at Buffalo in 1901 and a gold medal at the Saint Louis Exposition of 1904. In 1906 she became associate of the National Academy and in 1913 was president of the Society of Miniature Painters. She is also a member of the New York Water Color Club.

FULLER, Melville Weston, eminent American jurist and one of the chief justices of the Supreme Court of the United States. He was borne in Augusta, Me., 11 Feb. 1833; d. Sorrento, Me., 4 July 1910. He was graduated at Bowdoin College (A.M.) in 1853, and attended a course of lectures at the Harvard Law School (LL.D.), and was admitted to the bar in his native city in 1855. He began the practice of law, meanwhile becoming the associate editor of the *Age,* a Democratic newspaper. In 1856 he was elected city attorney and president of the common council. He resigned these offices and removed to Chicago, where he established an extensive law practice.

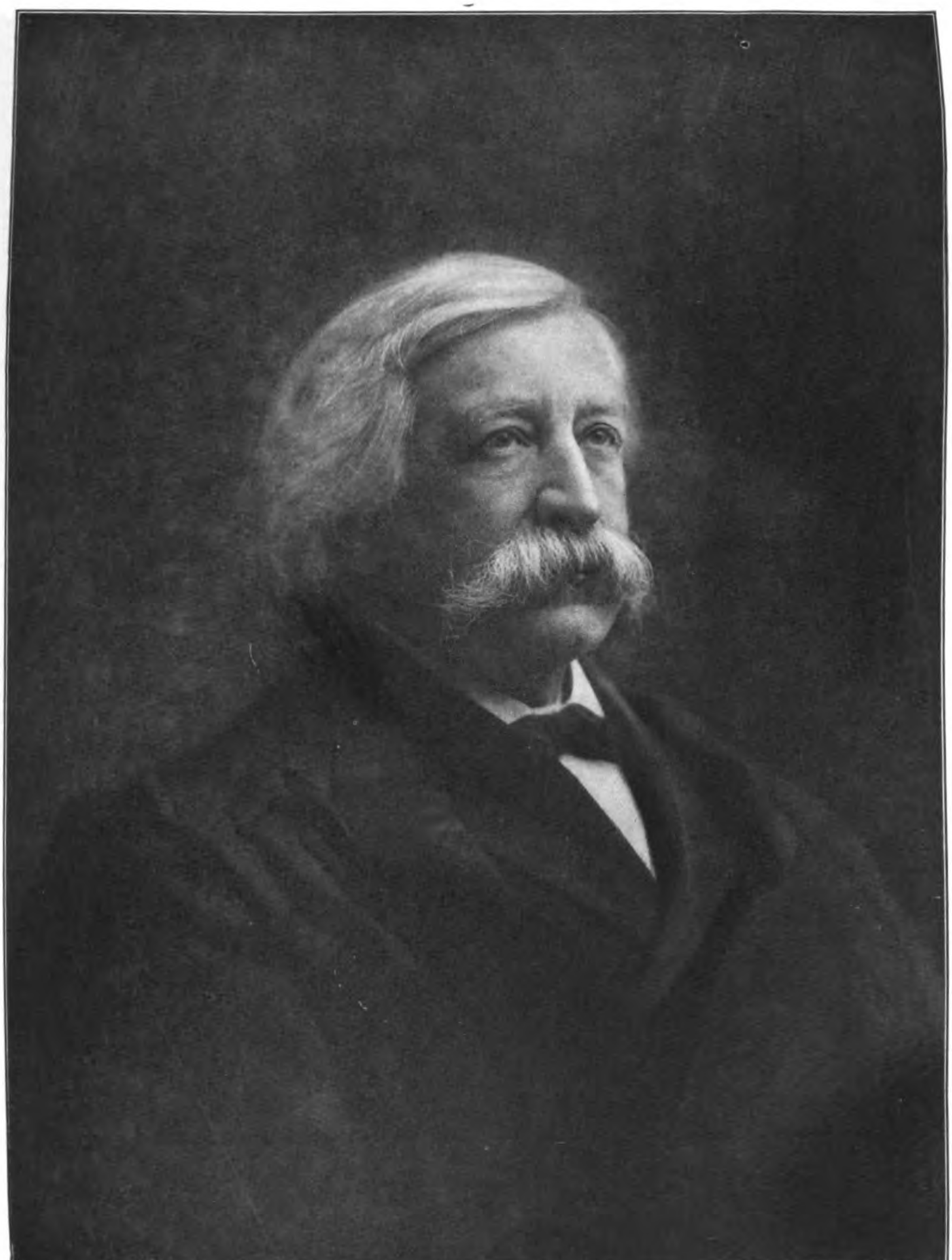
In 1862 he became a member of the Illinois State Constitutional Convention, and in the following year was elected from Cook County to the lower house of the State legislature. He rose rapidly in State and national politics, and from 1864 to 1880 was regularly a delegate from Illinois to the Democratic national conventions. In 1876 he placed Thomas A. Hendricks in nomination and was himself seriously considered as a candidate for presidential nomination in 1880. The same year he practically retired from politics, but gained additional fame as a lawyer during the next few years. In the famous lake-front case in Chicago he was counsel for the municipality, and in the Cheney ecclesiastical case, he defended Rev. C. E. Cheney, a Protestant Episcopal clergyman, rector of Christ Church, Chicago, against an action brought by an ecclesiastic council.

In April 1888 President Cleveland appointed him chief justice of the United States Supreme Court to succeed R. M. Waite (q.v.), deceased. He was confirmed 20 July 1888, taking the oath of office 8 October. About this time Bowdoin, Harvard College and the Northwestern University conferred degrees upon him. In the Supreme Court he soon became a prominent figure, and he was largely responsible for the expansion of Federal power, by means of the decision asserting the implied authority of the executive to protect the Federal judge on occasion when there is just reason to believe that, while in the exercise of official duties, he is exposed to personal danger. This was especially applicable to the case of one Nagle, an Arizona cowboy, who was made a United States marshal to protect the person of Chief Justice Field, and who while performing this duty shot and killed Judge Terry, of California. In December 1889, he delivered before the two Houses of Congress an address commemorating the inauguration of President Washington.

In 1899 Justice Fuller was a member of the Arbitration Commission convened at Paris for the adjustment of the Venezuela boundary question. In 1904–05 he was chosen by Great Britain as arbitrator at The Hague in the case of the French flag at Muscat. Consult an article by Reeder in *University of Pennsylvania Law Review* (October 1910), for a summary of his work in the Supreme Court.

FULLER, Richard, American Baptist clergyman: b. Beaufort, S. C., 22 April 1804; d. Baltimore, Md., 20 Oct. 1876. In 1820 he entered Harvard University, but was obliged, on account of feeble health, to leave during his junior year. He then studied law in Beaufort, was admitted to the bar and soon rose to eminence in his profession. During a period of great religious interest in Beaufort he felt it his duty to abandon the law and devote himself to the Christian ministry. At the same time he was constrained to leave the Protestant Episcopal Church in which he had been brought up. He was at once ordained, and called to the pastorate of the Baptist church at Beaufort. His reputation as a preacher soon became national and his services were widely sought in promoting religious revivals. During his residence in Beaufort he was engaged in two memorable controversies — one with Bishop England of Charleston, on the claims of the Roman Catholic Church, and the other with President Wayland, of Brown University on the subject of slavery. In 1836 he traveled in Europe for the benefit of his health and in 1846, became pastor of a Baptist church in Baltimore, Md., where he spent the remainder of his life. He was more than once president of the Southern Baptist convention. In addition to pamphlets and various sermons published separately, he was the author of volumes of 'Sermons' and 'Letters'; 'Argument on Baptist and Close Communion' (1849); 'Psalmist.' Consult the memoir by his nephew, James H. Cuthbert (New York 1879).

FULLER, Sarah Margaret (MARCHIONESS OSSOLI). American author: b. Cambridgeport, Mass., 23 May 1810; d. off Fire Island Beach, 16 July 1850. She derived her first teaching from her father, studied Latin at the age of six and injured her health by over-application. At 13 she was a pupil at the famous school of Dr. Park, in Boston, where she began the study



MELVILLE WESTON FULLER

of Greek. Thence she went to a school at Groton. On the sudden death of her father, she vowed that she would do her whole duty toward her brothers and sisters, and she faithfully kept the vow, teaching school in Boston and Providence, and afterward taking private pupils. During the transcendental period she knew intimately the leading minds of the time — Emerson, Hawthorne, Ripley, Channing, Clarke, Hedge — and in the company of such was very brilliant, meeting them as equals. She first met Emerson in 1835, and the next year visited him at Concord. She went occasionally to Brook Farm, though never fully believing in the success of that experiment, and never living there. She held conversations in Boston, conducted the *Dial,* translated from the German, projected works and wrote 'A Summer on the Lakes,' the record of a season spent in travel in 1843. In December 1844 she went to New York as literary critic of the *Tribune,* then under the management of Horace Greeley. While in New York she visited the prisons, penitentiaries, asylums, theatres, opera-houses, and lecture-rooms, writing about everything in the *Tribune* and doing much to move the level of thought on philanthropic, literary and artistic matters. She pursued this task unremittingly for about 20 months, after which, having saved a little money, she went to Europe in 1846. There she met the foremost people in the literary, social, political and reformatory world, spent the summer and autumn in travel, established herself for a time at Rome early in 1847, visited Switzerland and northern Italy and returned to Rome in the autumn. In December 1847 she was married to Giovanni Angelo, Marquis Ossoli, and entered with zeal into the Italian struggle for independence in 1849. Her conduct during the siege of the city by the French was of the most heroic, disinterested, humane and tender kind. She was a friend of Massini. On the capture of Rome in June 1849, she and her husband took refuge in Rieti, in the mountains of the Abruzzi, and after some months removed to Florence, which they later left for Leghorn, whence passage for America was taken on the *Elizabeth* that sailed 17 May 1850. The voyage ended in disaster; the vessel being driven ashore off Fire Island on 16 July 1850. The body of the child was borne ashore lifeless and neither father nor mother was heard of more. She wrote a good deal for magazines during her active literary period. Her collected works was edited by her brother, Rev. Arthur B. Fuller (Boston 1855). There are lives by Emerson, Clarke and Channing. There is also a memoir by Julia Ward Howe (in the 'Eminent Women Series,' Boston 1883) and one by Thomas W. Higginson (in 'American Men of Letters Series,' ib. 1884). Consult also Braun, F. A., 'Margaret Fuller and Goethe' (New York 1910); Dall, Mrs. C. H., (ed.) 'Margaret and Her Friends' (Boston 1895); Goddard, H. C., 'Studies in New England Transcendentalism' (New York 1908); Macphail, A., 'Essays in Puritanism' (Boston 1905).

FULLER, Thomas, Anglican churchman and historian: b. Aldwinkle, Northamptonshire, June 1608; d. London, 16 Aug. 1661. He was graduated from Queen's College, Cambridge. In 1630 took orders and was appointed perpetual curate of Saint Benet's parish, Cambridge, and became very popular as a preacher. In 1631 he became prebend in the cathedral of Salisbury. The same year he published a poem entitled 'David's hainous Sin, heartie Repentance, and heavie Punishment.' He gave up his Cambridge curacy in 1633, and next year became rector of Broadwindsor, Dorsetshire. His 'History of the Holy Warre' appeared 1639, soon after the publication of which he removed to London and was chosen lecturer at the Savoy church in the Strand. In 1642 he published his 'Holy and Profane State' (folio). In 1650 he published 'Pisgah Sight of Palestine and the Confines thereof, with the History of the Old and New Testament acted thereon' (folio), and in 1650 appeared his 'Abel Redivivus' consisting of lives of religious reformers, martyrs, divines, etc. In 1655 he published the 'Church History of Britain, from the Birth of Jesus Christ to the Year 1648'; to which was subjoined the 'History of the University of Cambridge since the Conquest,' and the 'History of Waltham Abbey.' The year after his death was published his principal literary work, the 'Worthies of England'— a production valuable alike for the solid information it affords relative to the provincial history of the country and for the profusion of biographical anecdote and acute observation on men and manners. Consult 'Life' by Bailey (1874).

FULLER, Thomas, Canadian architect: b. Bath, England, 1823; d. 1899. He studied at Bath and London; went to the West Indies, where he erected a cathedral at Antigua. In 1857 he went to Toronto, established his practice there and two years later, with his partner, Chilion Jones, was awarded first prize for designs for the Parliament buildings to be erected at Ottawa. He removed to Ottawa and remained there until 1867, in which year he entered the competition for the New York State Capitol at Albany, N. Y. His design was one of three to which were awarded equal premiums. In the second competition, with Laver, his design was adopted, and the capitol built from it. The same architects were also successful at this time in their design for a city hall and court buildings at San Francisco. Fuller resided in Albany until 1881, when he returned to Ottawa and was appointed chief architect of the Department of Public Works. He retired in 1897.

FULLER-MAITLAND, John Alexander, English musical critic: b. 1856. He graduated from Trinity College, Cambridge, in 1879, and in 1889 became musical critic of the London *Times.* He contributed to Grove's 'Dictionary of Music and Musicians,' the appendix to which he edited; translated (with C. Bell 1884) Spetta's 'Johann Sebastian Bach,' wrote a standard 'Life of Robert Schumann' (1884); 'Masters of German Music' (1894); 'The Musician's Pilgrimage' (1899); 'English Music in the Nineteenth Century'; and has in progress a new edition of 'Grove's Dictionary of Music.'

FULLERS' EARTH, a substance of indefinite composition, consisting essentially of clay, mixed with sufficient finely divided silicious matter to destroy its plasticity. Fuller's earth has a specific gravity varying from

1.8 to 2.5, and also varies in color. It is of very fine grain and received its name from the fact that for centuries its sole use was in cleansing («fulling») grease and oil from cloth and wool. In modern times its field of usefulness has been greatly extended. It is now an important agent in oil-refining, especially cottonseed and lubricating oils. The muddy oil is filtered through the earth and emerges clear. England was long the only large source of supply, the Cretaceous beds there furnishing great quantities. Cimolite, found in Greece is a variety of fuller's earth and has been used in similar fashion from the earliest times.

With the constantly rising prices for imported fullers' earth — due to the scarcity of ocean tonnage from 1914 on — the domestic production increased to the largest figure on record, reaching 67,822 short tons in 1916. The value of this output amounted to $706,951, an average of $10.42 per ton. The imports for the year amounted to only 16,801 short tons, of a value of $139,664, an average of $8.31 per ton. The relative ton price is informing as to the superior quality of the domestic product. Fully 80 per cent of the domestic product comes from the State of Florida. The other producing States are Georgia, Texas, California, Massachusetts and Arkansas. Large deposits have been located in Texas and California, but only one mine in each State was active commercially in 1916. The domestic product is nearly all used for clarifying and filtering fats, greases and oils, on which the earth exerts a bleaching effect. Only the imported earth is used for fulling cloth. (See MINERAL PRODUCTION OF THE UNITED STATES). Consult Ries, 'Clays, Occurence, Properties and Uses' (New York 1910) and Parsons, 'Bureau of Mines, Bulletin 71' (1913).

FULLERTON, George Stuart, American professor of philosophy: b. Fathegarh, India, 18 Aug. 1859. He was graduated from the University of Pennsylvania and in 1887 he was appointed professor of philosophy in the same institution. He was dean 1894–96, and vice-president 1894–98. Since 1904 he has been professor of philosophy in Columbia University. In 1913–14 he served as first American exchange professor to Vienna and other Austrian universities. In 1914 Emperor Francis Joseph appointed him honorary professor in the University of Vienna. He is the author of 'Preliminary Report of Seybert Commission on Spiritualism (1887); 'The Conception of the Infinite' (1887); 'A Plain Argument for God' (1889); 'The Philosophy of Spinoza' (1894); 'On Spinozistic Immortality' (1899); 'A System of Metaphysics' (1904); 'An Introduction to Philosophy' (1906); 'The World we Live In' (1912); 'The American Universities' (published in German 1914); 'Germany of To-day' (1915).

FULLERTON, Lady Georgiana Charlotte Gower, English novelist: b. Tixall Hall, Staffordshire, England, 23 Sept. 1812; d. Bournemouth, Hampshire, 19 Jan. 1885. She was married to Alexander George Fullerton in 1833 and followed him into the Roman Catholic Church in 1846. Her first novel, 'Ellen Middleton' (1884), was followed by 'Grantley Manor' (1847). Her later stories, after her conversion to the Catholic faith, are in a mild way «stories with a purpose,» the purpose being to develop the influence of religious belief on life and character; among them are 'Lady Bird' (1852); 'Too Strange Not to be True' (1864); 'Mrs. Gerald's Niece' (1869); 'A Will and a Way' (1881). She wrote also 'The Gold-Digger, and Other Verses' (1872). Consult Craven, 'Life of Lady Georgiana Fullerton,' translated from the French by H. J. Coleridge (1888).

FULLING, the act of cleansing, scouring and pressing woven woolen goods, etc., to render them stronger, firmer and closer; called also milling, because these cloths are usually scoured by a water-mill. The principal parts of a fulling-mill are the wheel, with its trundle, which gives motion to the tree or spindle, whose teeth communicate that motion to the pestles or stampers, which fall into troughs, wherein the cloth is put, with fullers' earth, to be scoured and thickened by this process of beating it. The operation takes from 48 to 65 hours, and results usually in considerable shrinkage in length and width; it obviates the tendency to unravel and renders the threads of the cloth so firm and close as to be almost imperceptible.

FULMAR, fŭl'mạr, a name applied to several species of petrels, of which the most common is the Arctic petrel (*Fulmarus glacialis*). This bird breeds on rocky coasts of the north Atlantic in enormous colonies, and goes southward in winter, some individuals as far south as New Jersey. It is about the size of a large duck. The head and neck are pure white; the back and long wings of a bluish or smoky gray; breast, belly and under surface white; bill large, strong and yellow or brownish; legs and toes brownish. The young are brownish gray. In the Hebrides, and especially in Saint Kilda, where these birds reside in incredible numbers, they are of great value to the people, not only for their eggs but also as a source of oil. The birds, when seized, vomit a quantity of clear amber-colored oil of a disagreeable odor which is one of the most valuable products of Saint Kilda. The old birds feed the very young with it. The fulmars breed on the faces of the highest precipices, on which every grassy shelf over a few inches in extent is covered with their nests, which are slightly excavated in the turf and lined with dry grass and withered tufts of sea-pink. One egg is deposited at a time, which the cliffmen obtain by descending with ropes from the summit of the cliffs. The fulmar feeds on animal substances, preferably fat. It flies buoyantly and swiftly, and withstands heavy gales, skimming the surface of the water. When a whale is caught, though few of the fulmars should be present, they assemble in thousands as soon as the cutting up is commenced; hence the whalers call them «whale-birds» or «mollymauks.» They follow in the greasy track of a whaling ship, coming within a few yards of the men engaged in cutting, and devour the morsels of fat voraciously and in great quantity, becoming quite tame. Other petrels which are classed as fulmars are the Giant Fulmar (*Ossifraga gigantea*), or «Cape Hen,» a bird 30 to 36 inches in length, and with a wing-spread of six to seven feet, common in the Indian and Antarctic oceans. This bird is exceedingly gluttonous, gorging itself until it can scarcely walk. Its favorite feast is carrion, and it has the filthy habit of vomiting its partly digested food when pursued. Rodgers' Fulmar (*Fulmar Rodgersii*) inhabits Bering Sea and adjacent waters as far south as the Bay of Monterey, California. The Pacific Fulmar (*F. g. glupischa*), is found along the north Pacific Coast as far south as Mexico. It is fearless of man, often disputing the catch with fishermen, and is easily captured.

FULMINATES, fŭl'mĭ-nāts, compounds of fulminic acid (C:NOH), all of which are violently explosive. The most important of these is mercuric fulminate, which is formed by dissolving 10 parts by weight of mercury in 120 parts of nitric acid of the specific gravity 1.34 and, when cooled, pouring this solution into 110 parts of 95 per cent grain alcohol. At the normal temperature a reaction sets in which becomes quite turbulent, dense white fumes being given off and then red fumes, and after this the mercuric fulminate separates out as a gray, crystalline powder. It has the formula of $HgO_2N_2C_2$, and belongs to the class of chemical substances known as oximes. Its specific gravity is 4.42. When moist it may be handled without danger, but when dry, mercuric fulminate explodes violently if struck or compressed or rubbed between hard surfaces; when heated to 367° F.; when touched with strong sulphuric or nitric acids; or when in contact with sparks from flint and steel or electric sparks. In all these cases the body undergoes a detonating explosion; and its principal use is to produce detonation in high explosives, though it is used also in percussion caps and primers to ignite gunpowder and other low explosives. Mercuric fulminate should be stored and transported only in the moist condition, yet even in this condition it can be exploded by the explosion of dry fulminate in contact with it. Certain amines like fulminating silver, gold, mercury and copper are frequently confounded with the fulminates because they also are explosive. The best known of these is Berthollet's fulminating silver, which was used in the bomb which killed Tzar Alexander II. This substance is produced only by the energetic oxidation of alcohol by nitric acid, in the presence of silver nitrate, the operation being performed in capacious vessels. It separates out as a black, crystalline mass, which explodes on the slightest concussion when dry and may even be exploded by rubbing between hard substances when moist, so that it requires the greatest caution in handling. It has been repeatedly formed accidentally in the ammoniacal silver solutions used in silvering mirrors and in the silver baths used in the wet processes of photography and has given rise to serious explosions. See EXPLOSIVES.

FULMINATION, a term used in chemistry to denote the violent decomposition of a substance, usually by heat or percussion, and accompanied by a flash of flame and a loud report, and differs therefore but little from detonation; except that the latter refers more to the sound, and the former to the flash. See DETONATION; EXPLOSIVES; FULMINATES.

FULMINIC ACID. See FULMINATES.

FULTON, Frederick John, Canadian statesman: b. Bedlington, England, 8 Dec. 1862. He received his education at Magdalene College, Cambridge, and after his arrival in Canada, began the practice of law at Victoria, B. C. He was elected to the British Columbia legislature as a Conservative in 1900 and three years later became president of the Council in the McBride Cabinet. Afterward he was successively Provincial Secretary, Minister of Education, Attorney-General and Commissioner of Lands. He was a member of the Irrigation Convention of 1907 and two years later served as chairman of the Timber and Forestry Commission. He did much for legislation on irrigation and forestry interests. He retired from public life in 1909.

FULTON, Robert, American inventor: b. Little Britain (now Fulton), Lancaster County, Pa., 1765; d. New York, 24 Feb. 1815. His father came from Kilkenny, Ireland, early in the 18th century, and settled in Little Britain. At the age of 13 Robert constructed paddle-wheels, which he applied with success to a fishing-boat. The years 1782–85 were spent in painting miniature portraits and landscapes, mechanical and architectural drawing, and whatever came in his way in the line of artistic work, at Philadelphia, where he numbered Benjamin Franklin among his friends. In 1786 Fulton went to London, and was received into the family of Benjamin West, under whose instruction he studied for several years. Afterward he practised his art in Devonshire, under the patronage of wealthy persons, among whom were the Duke of Bridgewater and Earl Stanhope. With his acquaintanceship with these persons begins his experiments in mechanics. Francis Egerton Bridgewater, last duke of that name, had become famous by the construction of a navigable canal from Worsley to Manchester, and Charles, Earl Stanhope, was the inventor of the Stanhope printing-press, and a student of mechanics and engineering. In 1793 Fulton actively engaged in a project for the improvement of canal navigation, and in the following year obtained from the British government a patent for a double-inclined plane for raising or lowering boats from one level to another on a system of small canals. In 1794 he patented a mill for sawing marble. Some time in 1796 he made plans for the construction of cast-iron aqueducts, and a great work of this kind was built for crossing the river Dee. A bridge built from his plans was erected at Wandsworth, and others at several points in Surrey. He also patented in England a machine for spinning flax, a dredging machine, a market or passage-boat, a dispatch boat, and a trader for use on canals. In 1796 he published his 'Treatise on the Improvement of Canal Navigation,' having previously published some articles on the subject in the London *Morning Star,* advocating small canals. Copies were sent by the author to the President of the United States and other officials, each accompanied by a letter emphasizing the advantages to be derived by the United States from canal navigation. In 1794 he became a member of the family of Joel Barlow, author of the 'Columbiad,' in Paris. Here he painted a panorama, the first ever shown in the French capital. In December 1797, Fulton made an experiment on the Seine with a boat for submarine navigation, to be used in torpedo warfare. In 1801 he conducted some experiments at Brest with his submarine or plunging boat, under the auspices of the French government, which, however, on Fulton's failure to blow up the British ships that sailed along the coast, became disaffected with the undertaking. At the instigation of Lord Stanhope, the government of England determined to secure Fulton's services for that country, and accordingly he went to London in May 1804, after a short sojourn in Holland. The submarine boat was finally reported by the British commission to be impracticable, but the torpedo they thought of some value, and Fulton was taken out with an expedition to try it against the French fleet at Boulogne, where the torpedoes burst harmlessly beside the French ships. An experiment in October 1805, with an improved apparatus, on a brig of 200 tons, provided for the purpose by the government, resulted in the destruction of the ship. In 1806 Fulton had returned to the United States, and renewed his experiments with torpedoes. His system was never adopted, though in 1810 Congress appropriated $5,000 for testing the torpedoes and submarine explosions. About this time Fulton invented a machine to cut the cables of ships at anchor. In 1813 he took out a patent for "Several Improvements in Maritime Warfare, and means for Injuring ships and vessels of war by Igniting Gunpowder under Water." Fulton began to turn his attention to the subject of steam navigation as early as 1793, as is shown in a letter to Lord Stanhope, written in that year. In 1803, having the financial assistance of Chancellor Livingston, Fulton launched a steamboat on the Seine, which, owing to faulty construction of the frame, immediately sank. Another boat was soon built, with the old machinery, and a trial trip was made but no great speed was attained. Encouraged with this partial success Fulton shortly afterward ordered an engine of Watt and Boulton to be sent to the United States. Early in the spring of 1807 the boat that was to navigate the Hudson and establish the system of steam navigation was completed at a ship-yard on the East River. The engine was put in later and on 11 Aug. 1807, the *Clermont* steamed up the Hudson to Albany, the voyage occupying 32 hours. During the autumn of 1807 the *Clermont* was run as a packet between New York and Albany. The success of Fulton's enterprise excited much jealousy and rivalry, and a number of persons disputed his claim to originality. Litigation and competition threatened to rob him of all profit from his invention. Fulton's first patent for improvements in navigation by steam was taken out 11 Feb. 1809, and another, with fuller provisions, on 9 Feb. 1811. Whatever may have been Fulton's honors as to the invention, he undoubtedly deserves the credit of first bringing into practical use the steamboat as a conveyance for passengers and freight, all earlier undertakings having been inefficient practically. The success of the *Clermont* was followed by the rapid multiplication of steamboats. A list of those built under Fulton's superintendence comprises the *Car of Neptune*, the *Paragon*, the *Fire-Fly*, the *Richmond*, the *Washington*, *Vesuvius*, *Olive Branch*, *Emperor of Russia*, the *Chancellor Livingston*, and many ferry-boats. He described his first ferry-boat in an article published in the *American Medical and Philosophical Register* for October 1812. In 1814, Fulton submitted to the coast and harbor defense committee plans for a steam warship to carry 44 guns, and in October of that year a boat of this description, called the *Demologos* (subsequently known as *Fulton the First*), was launched. The War of 1812 terminated before the effectiveness of the *Fulton* as a war vessel could be tested, and she afterward became a receiving ship. The last subject to which Fulton's energies were devoted was a modification of his submarine boat the *Nautilus*, but only the hull of the projected craft was completed before his death. Exposure in crossing the Hudson, after testifying in New Jersey in a steamboat case, laid the foundation of Fulton's last illness. He left a widow (daughter of Walter Livingston) and one son and three daughters. In 1909 the centennial anniversary of the *Clermont* was celebrated in conjunction with the tercentennial of the discovery of the Hudson by the navigator of that name. A replica of the *Clermont* was constructed and proceeded under its own steam up the river as its prototype had done exactly 100 years before. The literature of the steamboat controversy is extensive. The fullest list on the subject is afforded by Preble's 'History of Steam Navigation.' Fulton's published works are 'Treatise on the Improvement of Canal Navigation' (1796; French trans., 1799); 'Letters on Submarine Navigation' (1806); 'Torpedo War' (1810); 'Report on the Practicability of Navigating with Steamboats on the Southern Waters of the United States' (1813); 'Memorials of Robert Fulton and Edward P. Livingston in regard to Steamboats' (1814); 'Advantages of the Proposed Canal from Lake Erie to the Hudson River' (1814). Consult Colden, 'Life of Robert Fulton' (New York 1817); Dickinson, 'Robert Fulton, Engineer and Artist; His Life and Works' (ib. 1913); Knox, 'Fulton and Steam Navigation' (ib. 1886); Sutcliffe, 'Robert Fulton and the Clermont' (ib. 1909).

FULTON, Ill., city in Whiteside County, on the Mississippi River and Lincoln Highway, and on the Chicago, Milwaukee and Saint Paul, the Chicago, Burlington and Quincy, and the Chicago and Northwestern railroads, 36 miles northeast of Rock Island. The new high school building erected in 1914 at an expense of $40,000 and the Carnegie library are noteworthy. There are two banks, with resources aggregating over $1,000,000. The streets are paved, there is a good water system, and connection is made with Clinton, Iowa, by a high bridge over the Mississippi River. Pop. 2,174.

FULTON, Ky., city in Fulton County, 50 miles south of Paducah, on the Illinois Central. It is the seat of Tennessee College, a high school and Carr Institute and has machine shops, foundries, flouring mills, tobacco warehouses, lumber mills and harness works. The municipality owns the waterworks. Pop. 2,575.

FULTON, Mo., city and county-seat of Callaway County, on the Chicago and Alton Railroad, near the centre of the county, on Stenson Creek. Here are located the State School for the Deaf, Westminster College (Presbyterian), founded 1852; the Woods College, the Synodical College and State Hospital No. 1 for the Insane. Fulton is noted for its fire-brick and pottery works, and has a flouring mill, etc. The town was settled in 1821, and was incorporated as a city in 1859. There are three banks. The

ROBERT FULTON

value of taxable property in 1915 was $1,849,-437. The mayor and council are elected annually. The city owns and operates its electric-light and water plants. Pop. 6,000.

FULTON, N. Y., city in Oswego County, on the Oswego River and the Oswego Canal, and on the New York Central, New York, Ontario and Western and Delaware and Lackawanna railroads, 25 miles northwest of Syracuse. It has a public library, city hall, opera-house and other public buildings. It is the centre of the cheese trade of northern New York, and there are manufactures here of paper, woolen goods, flour, fire-arms, tools, water-motors, cutlery, paper-mill machinery, condensed milk, canned goods, knit goods, chocolate, infant's foods, macaroni, spark plugs, etc. The United States census of manufactures for 1914 showed within the city limits 51 industrial establishments of factory grade, employing 3,292 persons; 3,042 being wage earners receiving annually a total of $1,736,000 in wages. The capital invested aggregated $12,168,000, and the year's output was valued at $9,572,000: of this, $3,632,-000 was the value added by manufacture. Fulton was settled in 1791 and was originally incorporated as a village in 1835. The villages of Fulton and Oswego Falls, with an aggregate population of 8,206, were consolidated and chartered as a city in April 1902. A mayor and common council govern the city, being elected every two years by popular vote. The municipality owns and operates the waterworks. Pop. 11,138.

FULVIA, fŭl'vĭ-a, Roman matron: b. about 40 B.C. After being twice married she became the wife of Mark Antony. Antony divorced her to marry Cleopatra, upon which she attempted to persuade Augustus to take up arms against her husband. When this scheme did not succeed she retired into the East, where Antony received her with great coldness. This broke her heart and she soon after died.

FUMARIC ACID. See STEREOCHEMISTRY.

FUMAROLE, fū'mä-rōl, a volcanic vent, usually on the side of the main cone, from which gases issue. Due to the difficulty of approaching the main crater during an eruption, most of our information about volcanic gases is obtained from fumaroles. See VOLCANOES, and the section on *Volcanism* in the article on GEOLOGY.

FUMIGATION, an attempt at disinfection by gaseous agents. The term is also used to describe the application of the fumes of medicinal substances to the respiratory tract. Fumigation is probably, in its primary sense, a very unsatisfactory mode of bringing about disinfection. The agents that are used most effectively are chlorine gas, sulphur dioxide and formaldehyde. It has been distinctly demonstrated that chlorine gas as a disinfecting agent is untrustworthy, and that its application is attended with many disadvantages. Sulphur dioxide, in the absence of moisture, gives practically no results, and even when aqueous vapor is generated in a room previous to the use of the gas its bactericidal action is very slight. Moreover, sulphur dioxide in the presence of moisture in the air tarnishes brass and silver, gilt frames, etc., and corrodes fabrics and other stuffs. It is not a satisfactory disinfectant. Formaldehyde gas has been used since 1800 for fumigation. The vapor is extremely pungent, and it has a strong affinity for all organic substances. Its practical value as a disinfectant has been demonstrated to be above that of any other gaseous substance. It cannot, however, be said to give absolute results, and although its power of penetration is greater than in that of any of the others mentioned it is still only a surface disinfectant. The interior of a heap of clothing, for instance, if exposed to the gas, is not affected at all by it. Formaldehyde gas as a fumigant is not sufficiently strong to kill many household pests. This casts suspicion on its value as a room disinfectant. Moreover, it is very costly. In general it may be gathered that gaseous disinfection by fumigants is somewhat of a farce; and although formaldehyde gas approaches more closely the requirements of the ideal, it is far from being perfect. The best disinfectant for rooms is unquestionably sunlight. Short of this, thorough cleansing, rubbing down the walls, etc., should be carried out. As noted in the article on disinfection, it is the effort of hygienists to particularize on the type of disease agents which they desire to eradicate. The general modes of disinfection heretofore much in vogue were largely founded on a lack of knowledge of what the infecting agents have been. See BACTERICIDE; DISINFECTANTS.

FUMITORY («smoke of the earth»), a name commonly given to species of the genus *Fumaria.* It is a native European weed of delicate and beautiful appearance, which has been naturalized in America. The climbing fumitory or mountain-fringe of the United States grows well under cultivation. To the family *Fumariaceæ* belongs the genus *Corydalis,* found throughout most of the north temperate zone. Fumitory leaves have a bitter saline taste, and as a tonic and diaphoretic are used in provincial France as a blood-purifying remedy for scorbutic affections, chronic eruptions, etc.

FUNCHAL, fooṅ-shäl, Madeira, the capital and seaport of the island in the centre of a large bay on the south coast of Madeira. It is irregularly built; the streets are narrow, winding, ill-paved and dirty. An old castle, which commands the roads, stands on the top of a steep, black rock, called Loo Rock, surrounded by the sea at high water. The entire produce of the island, consisting mostly of wine and fruit, is exported from Funchal. Pop. about 19,600, among whom are many English, French, Portuguese and mulatto and negro freedmen. See MADEIRA.

FUNCK-BRENTANO, fuṅk brŏṅ-tä-nō, **Théophile,** French philosophical and critical writer: b. Luxemburg, 20 Aug. 1830; d. 1906. He became professor at the School of Political Sciences in Paris in 1873. His thorough studies in law and medicine have imparted to his philosophical writings an exactitude of thought and inspired a special stress on method, very apparent in such works of his as 'New Thoughts and Maxims' (1858); 'Exact Thought in Philosophy' (1869); 'Greek Sophists and Contemporary English Sophists' (1879); 'La civilization et ses lois' (1876); 'La politique' (1892); 'L'Homme et sa destinée' (1895); 'La science sociale, morale, politique' (1897); 'Les sophistes français' (1905), and others. As a critic he is esteemed for the happy presentation and careful elaboration of his thought.

FUNCTION. (1) *In biology,* the action proper to tissues, organs or groups of organs in plant and animal life. The function of respiration is the joint action of lungs and skin; digestion is a very compound function, to which organs and groups of organs contribute. The actions are capable of being grouped in subordination to three leading phenomena of every living thing — namely, sustentation, reproduction and relation. To the first belong digestion and all the other functions which contribute to the vegetative life; the processes of the second are, as examples of cell transformation, so far identical with those of the other two, but the results are different; the cell changes of the nervous system which regulates the relations of living things, are again identical with those of the other two sets of phenomena. Functional diseases are those due to organs perfect in structure but not performing their functions properly; as opposed to organic or structural diseases, due to defect of structure.

Organs often have more than one function — a *primary,* or that for which it is principally intended, and a *secondary,* some subsidiary purpose which it performs. It sometimes happens that important changes take place in the course of the evolution of a type, or the development of an individual, whereby the primary function disappears and some secondary use becomes pre-eminent or exclusive. Thus "a brilliant speculation," says Carpenter, "has indicated pairs of tracheal gills on the meso- and metathorax as the possible origin of insect wings. The primeval insects forsook, so it is thought, the water for the land; and the plates, becoming useless for breathing, were enlarged and finally changed into organs of flight." Another strong and familiar example is the case so often presented among crustaceans where the mouth parts are largely structures ("foot-jaws) originally ambulatory, but now entirely devoted to the seizing and mastication of food. Change of function results in change of structure. Consult Darwin, 'Origin of Species' (6th ed., London 1882); Dohrn, A., 'Der Ursprung der Wirbelthiere und das Princip des Functionwechsels' (Leipzig 1875); Marshall, A. M., 'Biological Lectures and Addresses' (London 1894); Saint George Mivart, 'Genesis of Species' (New York 1871). See also FUNCTIONALISM.

(2) *In mathematics,* one quantity is said to be a function of another, or of several others, when its value depends on those of the latter. Thus the area of a triangle is a function of its three sides, and $y=a+bx+cx^2$ is a function of a, b, c, and x. Functions receive distinctive names according to the nature of the dependence above referred to. Thus the function above written is said to be an algebraical function of x, since y is obtainable from x by the performance of a limited and definite number of algebraical operations. Log x, sin x, a^x, on the other hand, are said to be transcendental functions of x, and for obvious reasons receive the distinctive names of logarithmic, trigonometrical and exponential functions. The term function in its mathematical sense was due to Leibnitz (1692), but in its present sense was first defined by Johann Bernoulli (1718). Lagrange first used the term "theory of functions" in his 'Théorie des functions analytiques' (Paris 1797). The object of the theory is the study of functions of one or more variables, in which either the variables or the coefficients, or both, are complex numbers. Lagrange (1772, 1797, 1806) may be said to have been the real founder of this general theory but others before him — Newton, Leibnitz, Bernoulli, Clairaut (1734), D'Alembert (1747), and Euler (1753) — had already worked in its direction. Landen (1775) is usually credited with founding the theory of elliptic functions, though this theory had been suggested by Jakob Bernoulli (1691); Maclaurin (1742), and D'Alembert (1746). The real development of the theory, however, is due to Legendre, who after great labor produced his 'Traité des fonctions elliptiques et des intégrales Euleriennes' (1825–28). Abel, Jacobi and Cayley also contributed much to this theory. The present form of the general theory of functions is based largely on the works of Cauchy, Riemann and Weierstrass. For a list of the special functions consult Müller, 'Mathematische Terminologie,' in 'Bibliotheca Mathematica' (Leipzig 1901), a work in which are given about 200 functions. Brill and Noether, in 'Die Entwickelung der Theorie der algebraischen Functionen in älterer und neuerer Zeit,' in 'Jahresbericht der deutschen Mathematiker Vereingung' (Vol. II, Berlin 1894), gave a valuable history of the development of functions. Consult also Forsyth, 'Theory of Functions' (Cambridge 1893); Harkness and Morley, 'Theory of Functions' (New York 1893); and Merriman and Woodward, 'Higher Mathematics' (New York 1896), in all of which will be found the historical development, bibliography and full discussion of the theory of functions. See also articles in this encyclopedia: COMPLEX VARIABLE THEORY OF THE FUNCTIONS OF A; REAL VARIABLE, THEORY OF THE FUNCTIONS OF A; MATHEMATICS; TRIGONOMETRY; etc., to which extended bibliographies are appended.

FUNCTIONALISM (in psychology and philosophy). Functionalism is a term employed by modern writers both in philosophy and psychology. It occurs more commonly in psychological writers and it will be convenient to designate first the meaning which they assign to it. Functional psychology can be considered as dealing with three fairly distinct problems which we may discuss separately.

First: One of the fundamental problems which psychologists undertake to solve consists in the determination of the number and character of the various materials sensory, ideational, etc., which the mind employs, e.g., the varieties of color, tone, taste, etc. Their effort is directed to analyzing and describing both the elementary and the complex *contents* of consciousness. This field of endeavor is ordinarily entitled structural psychology. As contrasted with this, functional psychology undertakes to discern and portray the typical *operations* of the mind with especial reference to the *actual* life conditions under which consciousness occurs. In describing sensation, for example, it would find its sphere of interest in determining the character of the various sense activities like vision and hearing, as differing in their *modus operandi* from one another and from other mental processes such as thinking and willing.

This branch of functional psychology is found in all important psychological writers from Aristotle to the present day. It is not, however, until the present generation that any essential distinction has been recognized in this regard between structural and functional psychology. Indeed, as compared with the remaining forms of functional psychology, the distinction is relatively unimportant. It represents nevertheless a difference in emphasis which is significant. The functionalist is peculiarly resolute in his purpose to describe mental life as it is in the moment of experience. The analyses offered by the structuralist are perhaps apt to dwell too impartially upon details which may be evident to later introspective examination without having constituted noticeable features of the conscious state itself when it was in progress.

Substantially identical with this first conception of functional psychology, but phrasing itself somewhat differently, is the view which regards the functional problem as concerned with discovering *how* and *why* conscious processes are what they are. The structuralist is supposed to be occupied with the problem of determining *what* the conscious elements are and how they are combined. In general it will be seen that functionalism as thus described is roughly analogous to a physiology of mind, whereas structuralism is analogous to a mental anatomy.

Second: A broader conception of functional psychology and one more frequently characteristic of contemporary writers takes its rise from the prevailing interest in the larger formulæ of biology and particularly the evolutionary hypotheses within whose majestic sweep is nowadays included the history of the whole stellar universe. From this point of view functional psychology finds its peculiar problem in mental activity as part of a larger stream of biological forces. The psychologist of this stripe is wont to take his cue from the basal conception of the evolutionary movement, i.e., that for the most part organic life possesses its present characteristics by virtue of the efficiency with which they serve to meet the conditions laid down by the environment. With this conception before him he attempts to gain some understanding of the manner in which the psychical contributes to the furtherance of organic activities — not alone the psychical in its entirety, but much more the psychical in its particularities, mind as feeling, mind as judging, as willing, etc. He seeks to discover the exact nature of the accommodatory service represented by the various great modes of conscious expression.

Animal psychology affords a concrete example of the effort to discover these particularistic features of the adaptive service rendered by consciousness to organisms. Modern investigations in this field have thrown a flood of light upon such problems as the mechanism of instincts, the methods of animal topographical orientation, the scope and character of the several sense processes, etc. In a similar manner the studies of human genetic psychology, particularly that branch entitled child study, have contributed to our knowledge of the service rendered to the growing mind by its several different functions, such, for example, as the various sensations, the emotions, etc. Pathological psychology has also contributed in no small measure to our knowledge of the part played by particular portions of our consciousness in the development and organization of our mental life as a whole.

In this connection it is interesting to remark that not a few modern writers hold the view that every accommodation by an organism to a *novel* situation requires and involves consciousness. Such a view rests on the conviction that consciousness is not only of service from time to time in assisting organic adaptation to environment, but also that it is the absolute precondition of accommodation to situations which are new.

This broad biological ideal of functional psychology may be considered as issuing in the attempt to discover the fundamental utilities of consciousness. The problem from this point of view has not as yet been satisfactorily solved. It is possible to regard the three great familiar divisions of mental life, i.e., knowing, feeling, and willing, as constituting these basal utilities. There are, however, many subordinate categories which are equally significant; e.g., attending and judging. Moreover, from the strictly utilitarian standpoint it may be urged as practicable to reduce all these manifestations of utility to the basal one, selective accommodation; that is to say, it is because consciousness by its selective action leads to movements which result in the attaining of certain ends, that mind possesses value.

Third: It is sometimes asserted that functional psychology is in reality a form of psychophysics. This means that it finds its major interest in determining the relations to one another of the physical and mental portions of the organism. To be sure all psychology must necessarily entertain some doctrine regarding these relations, but functional psychology is occasionally identified with a peculiar attitude toward this problem which may be described as follows:

The distinction between the mind and the body is not regarded as founded primarily on a difference between two kinds of existence, one physical and the other mental. The two are rather thought of as different modes in which organic life expresses itself, now the one and now the other being more in evidence. Conscious processes are thought of as present whenever novel situations are to be dealt with and the fundamental business of consciousness is conceived to be that of building up efficient habits, or co-ordinations, to meet the necessities of these situations. The purely physical or physiological processes are on the other hand regarded as finding their peculiar sphere of action wherever old and well-formed habits are capable of meeting the requirements of the temporary environment. From this point of view mind and body are not so much two distinct entities as they are stages or aspects of the general process of vital accommodation to environment.

These three conceptions of functional psychology which have been described are obviously supplementary to one another. It is clearly impracticable to carry out a functional psychology which should deal with the problem of mind conceived as engaged in mediating between the environment and the needs of the organism without having some doctrine to offer concerning the connection of the mind and the body, for by common agreement consciousness makes itself effective through the muscular movements to which it leads. Some notion, therefore, of this connection must be involved. Moreover, it is equally certain that no effort to handle either of these problems can go far without some theory as to the basal character of the various mental operations themselves. The three positions must accordingly be regarded as complementary to one another. Their apparent divergence arises chiefly from emphasizing different aspects of a common problem.

The term functionalism, as has been already intimated, is less frequent in philosophy than in psychology. When used, however, it is generally employed as substantially identical with such terms as pragmatism and humanism. It does not represent a definite group of opinions and beliefs, but rather a certain attitude toward philosophical problems. This attitude may be illustrated by the comments in an earlier paragraph upon functional psychology conceived as concerned with the mind-body problem. In general, philosophical functionalism undertakes to discern the exact circumstances out of which the various problems of philosophy have grown, not only in the historical sense in which these problems are connected with the systems of particular movements or philosophers, but in the much more genetic sense in which they may be shown to come to light in the reflective processes of any human being. In a way, therefore, it might be designated a genetic philosophy.

In its purposes at least a philosophy of this kind is peculiarly vital, for it attempts to see the practical living significance of philosophical problems and it finds its solutions in the actual outcome in human life of the multifold factors with which metaphysical speculation finds itself confronted.

Bibliography.— Angell, 'The Province of Functional Psychology' (*Psychological Review*, 1907, p. 61); 'The Relation of Structural and Functional Psychology to Philosophy' (*Philosophical Review*, 1903, p. 203); Titchener, 'The Postulates of a Structural Psychology' (*Philosophical Review*, 1898, p. 449); Warren, 'The Fundamental Functions of Consciousness' (*Psychological Bulletin*, 1906, p. 217); Bawden, 'Functional View of the Relation between the Psychical and the Physical' (*Philosophical Review*, 1902, p. 474); James, 'Does Consciousness Exist?' (*Journal of Philosophy, Psychology, and Scientific Methods*, 1904, p. 477).

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FUNDAMENTAL CONSTITUTIONS. See COLONIAL GOVERNMENT, PROPRIETARY.

FUNDAMENTAL NOTE, TONE, or BASS. (1) The lowest or deepest tone that a string or pipe sounds in generating a series of harmonics. The fundamental note of a stretched string is sounded when the string vibrates as a whole. The fundamental note of an open organ-pipe is sounded when there is one node at the middle of the pipe. In a closed organ-pipe the closed end or stopper acts as the node when sounding the fundamental note. (2) The fundamental note also signifies the root of a chord, irrespective of the inversions of the chord; thus in the common chord of C, C E G, C is the fundamental note and remains so in the inversions E G C, G C E, E and G being called the bass notes.

FUNDAMENTAL ORDERS OF CONNECTICUT, a body of laws based on the Foundation Principles of Thomas Hooker (q.v.) and adopted in 1639 for the government of the Connecticut Commonwealth, settled by seceders from Massachusetts, who were dissatisfied with the latter's autocratic government. Although the preamble presumed the union of church and State, a distinctive feature was the absence of a religious test for citizenship, while the authority and even the existence of a sovereign or proprietor were ignored. Otherwise there was no great divergence from the legislation controlling Massachusetts. The governing authority was vested in the presiding officer of a court of magistrates and town deputies, elected at a court session by the town freemen. There was no separation of the executive, legislative and judicial functions. The general court in 1659 imposed a property qualification of $150 for suffrage. Some authorities state that this was the first written constitution known to history that created a government, and it continued in existence without material alteration for nearly two centuries. Consult Fiske, J., 'Beginnings of New England' (pp. 127–128; Boston 1889); Rines, I. E., 'The United States' (Vol. I, pp. 263–269; New York 1916).

FUNDAMENTALS, or BODY OF LIBERTIES, a colonial collection of laws prepared in 1641 by a convention of New England freemen who resented the arbitrary, undefined powers and prerogatives of the magistrates. A preliminary draft prepared by the council was first submitted to the local magistrates and elders, and was then sent broadcast to the freemen for consideration, suggestion and improvement. After considerable revision, about 100 laws were formally adopted, with the provision that after three years' trial they were to be revised and then become finally established. Church members were vested with the supreme power, but the supreme council possessed the power of veto. Every citizen was granted a certain share in the business of any public meeting, although universal suffrage was not conceded. The liberties of women, children and servants were defined in a more benevolent spirit, in harmony with the Mosaic code. A certain degree of liberty was granted to private churches and assemblies of different Christians, but the council had power to suppress arbitrarily any proceedings which they deemed dangerous or heterodox and to punish or expel their authors. Strangers and refugees who professed the true Christian religion were to be received and sheltered. Injurious monopolies were not to be allowed. Slavery, villainage or captivity was abolished, except in the case of lawful captives taken in war, or any case where slaves might be sold by others or should sell themselves. All torture was abolished, except whipping, ear-cropping and the pillory which were retained as necessary and wholesome, but death was the punishment for idolatry, witchcraft and blasphemy, or for the wilful disturbing of the established order of the State. Consult Palfrey, J. G., 'History of New England' (Vol. I, pp. 229–282; 4 vols. 1873).

FUNDED DEBT. See DEBT, NATIONAL.

FUNDI, or FUNDUNGI, a kind of grain obtained from a grass, *Paspalum exile,* allied to the millets, which is cultivated to a considerable extent in the western part of Africa. It is wholesome and nutritious and is much used by the natives of western Africa as a food.

FUNDING, in finance, the conversion of floating debt into an interest-bearing obligation with a definite period, on which bonds can be issued. One such operation is of special interest in United States history, as part of the operations by which Hamilton, as leader of the Federalists (q.v), and then secretary of the treasury, succeeded in setting the government on a firm foundation. The Act of 4 Aug. 1790 founded not only the foreign and domestic debt in full, but the State debts incurred in carrying on the Revolutionary War; the bonds were at 6 per cent, but those for the domestic debt did not bear interest till 1800.

FUNDS, Public. See DEBTS, PUBLIC.

FUNDY, Bay of, a huge arm of the Atlantic Ocean extending into the land between New Brunswick and Nova Scotia, and the State of Maine, and terminating in two smaller bays, Chignecto Bay and the Basin of Minas. Its length up to Chignecto Bay is 140 miles, and its extreme breadth 45 miles. It is noted for its high tides, which are influenced by the Gulf Stream, and rise about 30 feet at Saint John and 60 feet at the head of Chignecto Bay, rushing into the latter with remarkable force. At Bay Verte, 14 miles distant, the tide rises little more than four or five feet. Along its northwest side the Bay of Fundy receives the Saint John, the largest river in New Brunswick, and also the Saint Croix. The tides in the Fundy are perilous to navigation and produce dangerous bores, especially in the upper reaches of the Bay. At low tide there is a long expanse of mud flats, at times over two miles in length, and the inreaching estuaries are completely drained. At the entrance to the Bay of Fundy are the Grand Manan and other islands. See TIDES.

FUNEN, Denmark, an island of the Danish archipelago, separated from Jutland by the strait called Little Belt; area 1,133 square miles; pop. about 252,288. Its shores are deeply indented; its interior is undulating, and there are numerous lakes, streams and marshes. The largest stream is the Odense, 36 miles long. The soil is extraordinarily fertile and well watered. Grain is produced and considerable amounts are exported. Stock farming is also extensively carried on. It trades principally with Sweden and Norway. It forms with other islands a province of Denmark (q.v.). Chief towns: Odense, Svendborg and Nyborg.

FUNERAL RITES, the last religious and ceremonial tribute of friendship and love paid to the remains of the dead. Funeral rites have developed from the belief that the dead are not really dead and the desire to propitiate or alleviate the departed spirit. Among the Hindus the corpse is perfumed and adorned with flowers; it is then burned; after many ceremonies the bones are deposited in a casket and buried, but afterward disinterred and thrown into the Ganges. A second series of obsequies commences after the period of mourning has expired, and this is followed by commemorative rites. The voluntary immolation (*suttee*) of the widow of the deceased, now abolished, was the most remarkable part of the ceremony. The Mohammedans bury their dead. The interment takes place as soon as possible, in obedience to the command of the prophet: «Make haste to bury the dead, that, if he have done well, he may go forthwith into blessedness; if evil, into hell-fire.» No signs of excessive grief, no tears nor lamentations, are allowed, as it is the duty of a good Mussulman to acquiesce without a murmur in the will of God. On arriving at the burial place the body is committed to the earth with the face turned toward Mecca. Monuments are forbidden by the law, but they are constantly erected. The Egyptians embalmed their dead. Among the Jews the next of kin closed the eyes of the deceased; the corpse was then washed, and, in the case of persons of some consequence at any rate, laid for a time in spices or anointed with spices, swathed in linen bandages, and deposited in the tomb. The mourning customs of the Jews may be collected from various passages of the Scriptures. They went bareheaded and barefoot, covered their mouths and kept silence, put on sackcloth, and sat in ashes; funeral songs were sung by persons hired for the purpose; splendid monuments were sometimes hewn out of the solid rock, with numerous niches; as each niche was filled, its entrance was stopped up by a large stone rolled against it. In the religious creed of the Greeks and Romans sepulture was an act of piety to the dead; without it the spirit had to wander 100 years on the banks of the gloomy Styx. The last breath was generally caught by a near relative, who opened his mouth to receive it; the body was washed and crowned with flowers, a cake of flour and honey placed in the hand, as a bribe for Cerberus, and an obolus in the mouth, as a fee for Charon. Interment and burning were practised indifferently. In interment the body was placed with the face upward and the head toward the west. In burning the pile varied in form and material; it was lighted by the nearest relative; perfumes and wine were poured on it, and the richest clothes of the dead were burned with him. The ashes were then collected and deposited in an urn. This description relates to both Greeks and Romans, whose rites were nearly identical.

In the Roman Catholic Church the body is washed immediately after death, a crucifix is placed in the hands, and a vessel of holy-water at the feet, with which the visitants sprinkle it. The Ritual prescribes that the corpse be borne in procession from the house in which it lies to the church, attended by the parish priest with acolytes and servitors all in cassock and surplice, and one of them bearing the processional cross in the van. Before the procession moves, the priest first sprinkles the coffin with holy-water and recites the *De profundis* and the *Miserere* while the procession is in movement. Taken into the church, the coffin is laid on trestles in the middle of the nave, the feet to the east or the sanctuary, if the deceased was a layman, the head to the sanctuary if he was a priest; lighted candles surround the coffin. Then follows the Office for the Dead, and after that the Mass for the Dead. After the Mass the priest, attended by the acolytes, pronounces the Absolution and certain prayers, meanwhile sprinkling the coffin with holy-water and fumigating it with frankincense. The procession is now re-formed and the body borne to the place of burial. There the *Benedictus* is sung or recited, followed by an Antiphon, *Ego sum resurrectio et vita* (I am the resurrection and the life); the corpse is again sprinkled, a final prayer is pronounced, and the body is laid in the grave or tomb. In the funerals of children, the vestments of the clergy are white instead of black, joyous psalms are chanted or recited, there are antiphons of praise and thanksgiving instead of petitions for mercy and forgiveness; and the church bell is not tolled.

In the Greek Church there are distinct services for laymen, monks and priests severally. The officiant holds a short service at the house of the defunct; service is held at the church, to which the body has been brought, and then at the grave, where the priest takes a shovel and sprinkles dust cross-wise on the body. Finally, before the grave is closed, he casts wax or ashes from his censer upon the coffin.

The English Church, followed very closely by the Protestant Episcopal Church in the United States, uses the order for the Burial of the Dead in the Book of Common Prayer. It is a stately and somewhat elaborate service, which is frequently used in part by other Protestant bodies. The first section of the service is recited in church, to which the body has been brought, or at the house of the defunct. It consists of anthem, psalms and a lesson. The second section, sometimes called the committal, is recited at the grave, where dust is scattered on the coffin as it has been lowered. Consult Yarrow, H. C., 'Introduction to the Study of Mortuary Customs among the North American Indians' (Washington 1880); Jevons, F. B., 'Introduction to the History of Religion' (London 1896); Frazer, J. G., 'The Golden Bough' (ib. 1900); Tylor, E. B., 'Primitive Culture' (ib. 1903).

FÜNFKIRCHEN, or **PÉCS,** Hungary, capital of the county of Baranya, 110 miles southwest of Budapest. The name is derived from five Turkish mosques, three of which are now in ruins and two in use as churches. There is a fine 12th century cathedral in Romanesque style. It contains a gymnasium, seminary, military school, vocational school, a library and museum. Church organs, leather, cloth and pottery are manufactured and there is a brisk trade in coal, wine, fruit and tobacco. From 1543 to 1686 the town was in the hands of the Turks. It is probably the Roman Colonia Serbinum. Pop. 50,000.

FUNG-HUANG, the Chinese phœnix, regarded as a harbinger of prosperity; also as an emblem of good luck. For the mythological lore concerning it, Consult Griffis, 'China's Story in Myth, Legend, Art and Annals' (New York 1911); Macgowan, 'Chinese Folk Lore Tales' (London 1910); Mayers, 'Chinese Reader's Manual' (Shanghai 1875).

FUNGI, fŭn'jī (singular *Fungus,* Latin name for mushroom), the general name applied to a multitude of lower plants of quite diverse structure, but which agree in not containing chlorophyll, the green coloring matter of the vegetable kingdom. Formerly the fungi were regarded as constituting a natural group (class or order), but are now recognized by modern botanists as belonging to many natural groups of plants.

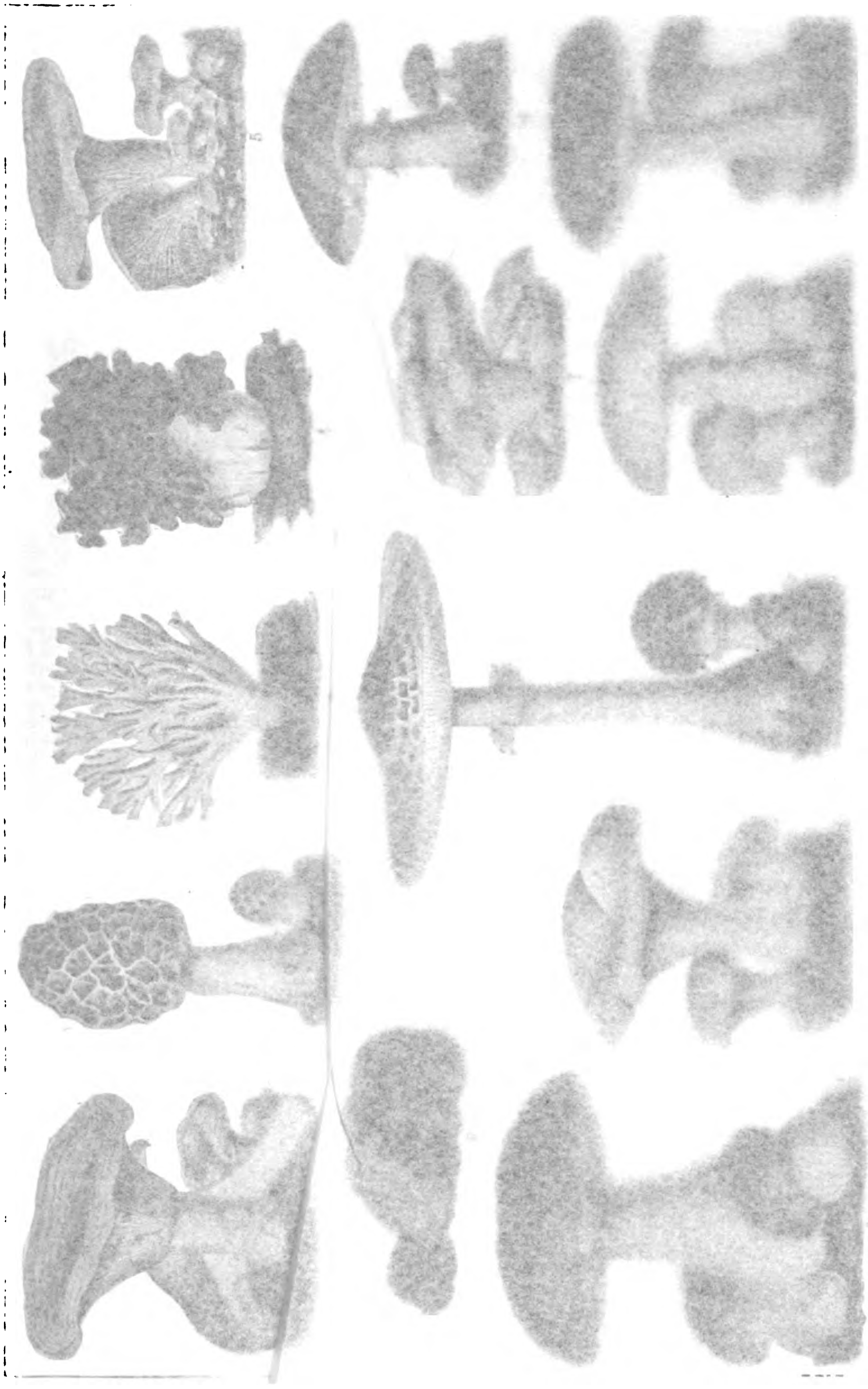
The peculiarities of fungi are physiological; they result from their food habits, and are not primarily structural and of profound significance. When we enumerate the physiological changes involved in the change of a plant from an independent life to one of parasitism or saprophytism, we have considered all of the essential differences between the fungi and the green plants from which they have been derived. We may say then, that a fungus is a lower plant which has suffered certain physiological changes on account of the fact that it has become parasitic or saprophytic.

Before going farther it is necessary to define certain terms which must be used in any discussion of the fungi. A plant is a *parasite* when it lives upon or in another living plant, absorbing food from it, and living at its expense. The mere fact of growing upon another plant does not make the first parasitic, for there are many small plants which merely find lodgment upon larger species, not, however, absorbing anything from the plants on which they are lodged. When it is necessary to distinguish such plants, they are called *epiphytes.* In the case of parasites the plant or animal upon which they live is spoken of as the host. When a plant lives upon an organism which is no longer living or upon its products it is called a *saprophyte.* Thus the toadstools which grow so freely on manure and other decaying vegetable matter are saprophytes. It is sometimes necessary to have a term to apply to plants which are neither parasitic nor saprophytic, and then we use the word *holophyte.* Thus all common green plants are holophytes. When it is desired to contrast holophytes with both parasites and saprophytes, we can use the term *hysterophyte* for the parasitic and saprophytic plants.

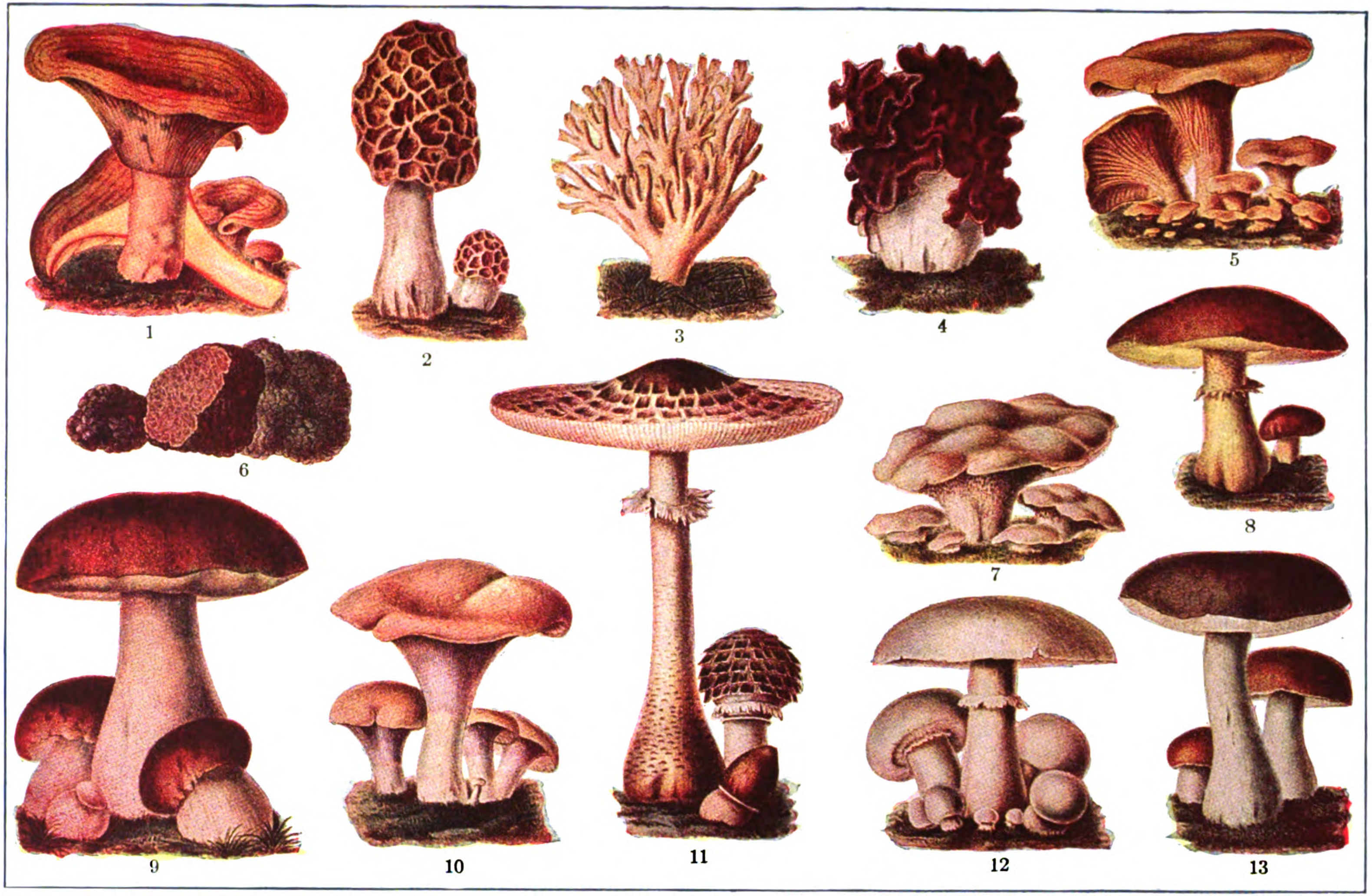
Applying the terms we have now defined, we may say that all fungi are hysterophytes, some living parasitically upon their hosts, others living saprophytically.

All holophytes are green in color, although in many this is concealed by other pigments and the significance of this is purely physiological. Green plants absorb the gas carbon dioxide, and in green cells this is combined with some of the elements in the ever-present moisture of the plant into a chemical compound allied to starch and sugar, and characterized by consisting of nearly equal amounts of carbon and oxygen, combined with nearly double the amount of hydrogen.

Such compounds are known as carbohydrates and they are made by all holophytes, and then used in the processes of assimilation and growth. It has been demonstrated that plants which are not green cannot make the carbohydrates, and since all plants need these compounds for building up their tissues, it follows that colorless plants must obtain them by taking them from living or dead green plants. Last, it should be borne in mind that even green plants cannot make the carbohydrates in darkness. For this work they need light and in fact the greatest importance of light to a plant is in connection with this process of making



EDIBLE FUNGI



1. Delicious Lactaria (Lactaria deliciosa)
2. Morel (Morchella esculenta)
3. Yellow Coral-fungus (Clavaria flava)
4. Saddle Fungus (Helvella esculenta)
5. Chanterel (Cantharellus cibarius)
6. Truffle (Tuber melanosporum)
7. Hedgehog Fungus (Hydnum repandum)
8. Ringed Boletus (Boletus luteus)
9. Stone-fungus (Boletus edulis)
10. Plum Mushroom (Clitopilus prunulus)
11. Parasol Mushroom (Lepiota procera)
12. Cultivated Mushroom or Champignon (Agaricus campestris)
13. Rough-stemmed Boletus (Boletus scaber)

carbohydrates. Accordingly plants which are not green, and which as a consequence do not make carbohydrates, often grow in darkness or in feeble light. This is quite characteristic of the fungi, great numbers of which grow as well in darkness as in light, or in some cases grow even much better in the darkness than they do in the light.

The fungi are very numerous, some recent estimates placing the number of species as high as 250,000, of which not more than one-third have as yet been described. They occur wherever there is organic matter of any kind upon which they can subsist. Wherever there are living plants or animals there are fungi which obtain food either from the living cells of their hosts, or the dead and cast-off cells and tissues. Some species occur in the lower layers of the air, in all exposed waters and in the soil. They are the most numerous of living things when we consider individuals alone. They range in size from extremely small to many centimeters in length. The smallest are far too minute to be seen by the naked eye, some being visible only by the aid of the most powerful microscopes. Of some of the smallest species it would require 25,000 to 30,000 placed side by side to measure one inch. On the other hand there are toadstools a foot or so in height and diameter, and puff-balls two to three feet in diameter have been recorded.

The fungi as thus described are found in four of the grand divisions (phyla) of the vegetable kingdom.

Phylum, Myxophyceæ. The Slime Algæ. — Here are gathered a thousand or so species of microscopic aquatic plants in which the cells have a very low organization. No distinct nucleus is present, and the coloring matter in the typical plants pervades the whole cell, and is of a bluish or brownish-green color instead of a bright green as in higher plants. They reproduce by simple fission, and by the production of spores. There is no hint of any sexual reproductive process. They occur in ponds, pools and streams, to which they give a greenish color by their great numbers. In decaying they usually give off a fetid odor.

While the typical Slime Algæ are greenish — and are known as green slimes — many have become parasitic or saprophytic, and have lost their green color. These colorless species are known as Bacteria, and are the lowest of the fungi.

Bacteria (Fig. 1) are then to be regarded as colorless green slimes, their lack of color

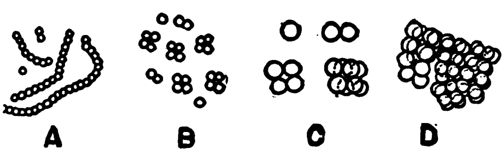


FIG. 1.— Bacteria. A, *Streptococcus pyogenes;* B, *Micrococcus tetragenus;* C D, *Sarcina lutea.* All highly magnified.

being due to their parasitic or saprophytic habits. Some species are minute rounded cells of remarkable minuteness. To these the generic name *Micrococcus* has been given, and many species have been recognized by botanists. Other genera with spherical cells are *Streptococcus, Staphylococcus, Sarcina,* etc. Other bacteria consist of cylindrical cells which tend to adhere end to end in filaments or rods. In the genera *Bacillus* and *Bacterium* the rods are straight or little curved, and short or of moderate length, while in *Vibrio* and *Spirillum* the rods are more or less spirally curved. In still other genera, as *Crenothrix, Leptothrix,* etc., the rods are elongated. The study of Bacteria

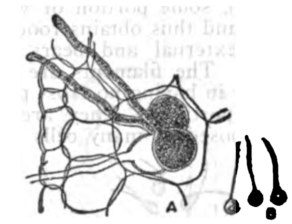


FIG. 2.— A, *Olpidium brassicæ,* one of the simplest of the fungi (*Synchytriaceæ*), parasitic in cells of a crucifer: B, three zoospores. Highly magnified.

in relation to diseases of man and other animals and of plants, and to soils, etc., has developed into the science of Bacteriology (q.v.). Many botanists now, on that account, do not include Bacteria among the Fungi. See BACTERIA.

Phylum Chlorophyceæ and Phylum Siphonophyceæ.— These plants, of which there are probably nearly 2,500 species, may very properly be called sea-weeds, since they are typically aquatic, living in the salt and fresh waters of the earth. Typically they are bright green, and the cells of which they are composed have well-formed nuclei. However, the chlorophyll is confined to definite portions of the protoplasm, and is not diffused throughout the cell. Some of the lower species are spherical, rounded cells, but for the most part they consist of filaments of cylindrical cells, or in some instances they are masses of cells constituting leafy-stemmed plants. They reproduce by fission as in the Slime Algæ, but in addition all, or nearly all, Slime Algæ reproduce sexually also. In the simplest cases of sexuality, two equal and similar cells detached from older plants fuse into a new and larger cell, and then this new cell grows into a new plant. Sometimes the new cell becomes covered with a thick wall, and for a time ceases activity as a "resting spore," before it develops into a new plant.

While most of the plants of these two phyla are green plants, several hundred species have become parasitic or saprophytic in habit (Figs. 2 to 10) and have therefore lost their color, and become fungi. Among these are the following families, namely:

Gall Fungi (*Synchytriaceæ*) are beyond reasonable doubt to be regarded as hysterophytic forms of the one-celled class (class *Protococcoideæ*) of the first of these two phyla. These fungi consist of single cells which enter the cells of their living host plants and there enlarge, feeding on the host cells and causing an irritation of the tissues which often causes swellings which may be minute or in some cases very large (e.g., wart disease of potato tubers caused by *Synchytrium endobioticum*). The fungus cell eventually breaks up internally into numerous minute zoospores which escape in various ways and infect new host cells. (Fig. 2). The family *Chytridiaceæ* (Fig. 3) which are mostly parasitic in aquatic algæ and fungi are probably closely related to these or to the next forms.

Water Molds (*Saprolegniaceæ*) which are minute filamentous, colorless plants living in the water on living and dead plants and animals. (Fig. 4). Each plant is a more or less branched thread, some portion of which penetrates the host and thus obtains food, while the other part is external and bears the reproductive organs. The filaments are cylindrical, and are peculiar in having no cross partitions in the vegetative portions. They are to be regarded as composed of many cells which have

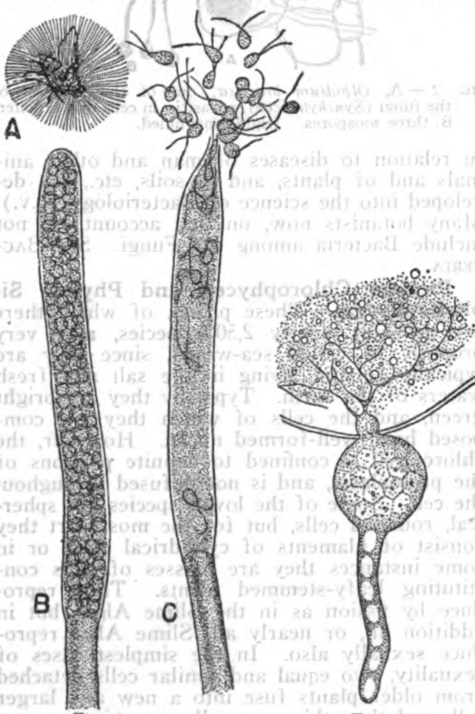


FIG. 4 FIG. 3

FIG. 3.—*Rhizidiomyces apophysatus*, another of the lower fungi (*Chytridiaceæ*); the root-like organs are parasitic in a cell of a water mold. Highly magnified.
FIG. 4.—*Saprolegnia* thureti; A, fly with reproductive filaments; B, end of a filament forming zoospores. C, zoospores escaping. A, natural size; B and C, highly magnified.

not separated themselves by partitions. The nuclei are numerous, and very small.

The more common mode of reproduction is as follows: A terminal portion of a branch forms a partition at some distance from the extremity and the protoplasm in this segment becomes denser, and a little later divides into a great number of small cells, each of which remains naked (that is, no cell wall is formed around it), and soon escapes by a rupture of the end of the segment. (Fig. 4). These escaped cells are known as zoöspores, since they have a very active swimming motion, very like that of some of the lower microscopic animals. The similarity to the lower animals is shown still more by the identity in their locomotive organs, which consists of one or two slender protoplasmic whips (flagella) by whose rapid lashing the zoospores are propelled. After a short period of activity they come to rest, when they cover themselves with a cell wall, and begin to elongate into a filament like that of the

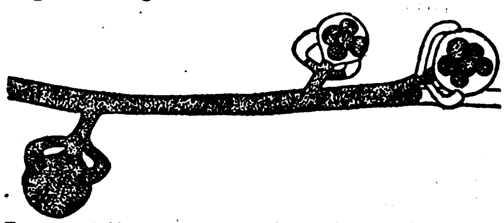


FIG. 5.—*Achlya racemosa*, showing antherids and oögones. Highly magnified.

plant from which they came. Reproduction by means of zoospores is very rapid, since they are formed in such great numbers when conditions are favorable.

The sexual organs, which are rather rarely formed, consist first of an enlarged and rounded end segment in which the protoplasm is quite dense. From the sides of the branch below the end segment (or from elsewhere on the body of the plant) slender branches grow up and in turn their ends become cut off by cross partitions. (Fig. 5). The first end segments (the rounded ones) are oögones, or in plainer words they are egg-organs, and in them one or more eggs are produced. The second segments (slender) are male organs called antherids, and the protoplasm they contain has the function of the spermatozoids of many plants (and animals). At the proper time the antherids puncture the egg-organs, and by the inflow of the contents of the former the eggs are fertilized. Later these eggs may germinate and produce new plants like those on which they were borne.

Downy Mildews (*Peronosporaceæ*) are much like the water molds, but instead of being aquatic, they live in the tissues of land plants. Like the water molds they are composed of branching, non-septate filaments. The main body of the plant usually grows in the intercellular spaces of the host, where there is nearly as much moisture as under aquatic conditions. In a few species, however, including the organism of the Late Blight of the potato (*Phytophthora infestans*), the filaments grow directly through the cells of the host, killing them in advance by a poisonous secretion sent out by the fungus. (Fig. 6). From this inter-

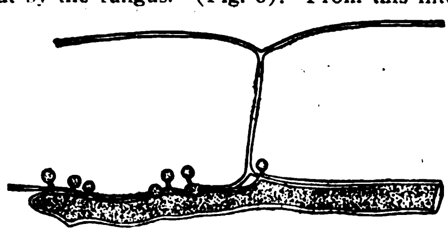


FIG. 6.—Portion of a filament of *Albugo candida*, with its haustoria penetrating host cells. Highly magnified.

nal part of the fungus short branches grow out into the air, and these become swollen terminally into rounded segments, which are in fact short zoosporangia. Instead of forming zoospores at once, they first fall off and then those that fall into water develop zoospores, much as in the water molds. As these structures are very minute, a droplet on a leaf is large enough for the germination of hundreds of the detached zoosporangia. Here again, the zoospores, after coming to rest, develop into new plants, which at once penetrate the host. In some species the zoosporangia grow at once into a filament, without forming zoospores.

The sexual organs of downy mildews are much like those of water molds, the differences being quite immaterial for the present discussion. (Fig. 7).

It is evident from a comparison of the structure and reproductive organs of water molds and downy mildews, that the latter are derived from the former. Just as the water molds have been derived from the green plants of the Green Felt family (*Vaucheriaceæ*) by the adoption of parasitic and saprophytic habits, so by the change from strictly aquatic conditions to those found in the intercellular spaces of land plants, water molds have been changed to downy mildews. Every difference between the two families may be accounted for by this difference in the environment of the plants.

Black Molds (*Mucoraceæ*) show an additional modification of the water mold type. They are non-aquatic, mostly saprophytes, a few only being parasites. They live for the most part on dead organic matter, animal or vegetable, which is still moist, and but few species can live in the water. The commonest species live on the starchy and sugary substances in pantries, cellars and other places where these substances are found in the presence of sufficient moisture. Organic substances which are dry are not attacked by black molds.

Each black mold plant is a branching tubular filament, which has few cross partitions. One part of the plant usually grows in the substance of the organic matter, and another grows

Fig. 7

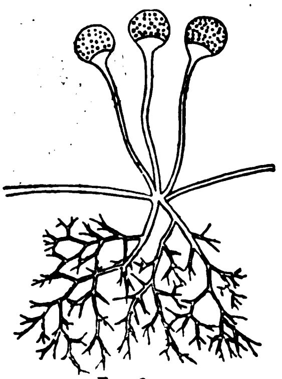


Fig. 8

Fig. 7.— *Peronospora alsinearum*, showing antherid penetrating the egg-cell. Highly magnified.
Fig. 8.— *Mucor stolonifer*. Highly magnified.

upward into the air. (Fig. 8). The former absorbs food matter, while the latter bears reproductive organs, as in the water molds. The ends of the aerial branches enlarge as in the two preceding families, but instead of forming zoospores, the protoplasm in the terminal segments forms many small spores, each covered with a cell wall. These spores are the homologues of the zoospores in previous families, but as the plants are not aquatic, these zoospores have ceased to be aquatic also. With a good cell wall to protect their protoplasm, they may be blown about in the air without drying up. It is in this way, in fact, that black molds are propagated, the air currents carrying the spores sometimes for long distances, and when they fall upon organic matter under

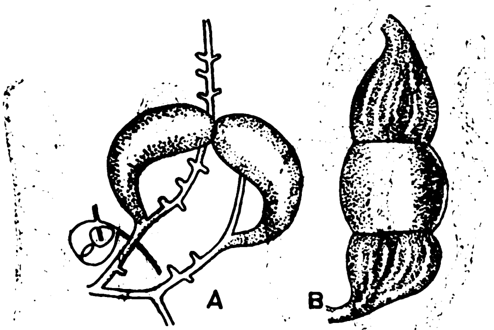


Fig. 9.— *Mucor fusiger;* A, young sexual organs; B, after fertilization. Highly magnified.

favorable conditions they quickly give rise to a new crop of mold plants. On the filaments which penetrate the nutrient substance, or grow over its surface, are to be found (rarely, however, in the common species) sexual organs somewhat resembling those of the two preceding families. (Fig. 9).

Insect Fungi (*Entomophthoraceæ*) are somewhat similar to black molds, but are parasitic in the body tissues of insects, and accordingly show considerable structural modifications. (Fig. 10).

Phylum Carpomyceteæ. The Higher Fungi.— This immense phylum, containing over 60,000 recognized species and probably twice as many, if not more, not yet studied, seems to have arisen from chlorophyll-bearing plants of the phylum Rhodophyceæ, the Red Seaweeds. These are mostly marine, although many fresh-water species are known. They reproduce sexually by the union of a non-motile sperm with the elongation of the oogone, termed trichogyne. The male nucleus passes down this to the egg nucleus with which it unites. The fusion nucleus thus produced divides very freely and the daughter nuclei pass out into many branching threads whose terminal cells (*carpospores*) are the reproductive cells of the plant. The whole structure of oogone, branching threads and carpospores is a "spore-fruit" and may or may not be surrounded by a protective structure of vegetative cells. In the Higher Fungi we find similarly a spore-fruit arising as a result of the sexual process. The ultimate cells are of three kinds, depending upon which one of the three classes is under consideration. (See Vegetable Kingdom and Plants, Morphological Evolution of). These classes are the Ascomyceteæ, Basidiomyceteæ and Teliosporeæ. Beside these there is a large group of fungi, certainly belonging to this phylum but which in the lack of knowledge as to their sexual reproduction cannot with certainty be assigned to any one of these classes. These are the Imperfect Fungi. All the plants of this phylum possess branching threads with numerous cross walls (septa) and usually one or two nuclei to a cell. Asexually they produce by conidia, cells cut off from the ends of unmodified or specially modified threads. The cells so produced possess walls and are distributed by the wind, rain, insects, etc.

Sac Fungi (class *Ascomycetea*).— The distinguishing mark of the plants of this class

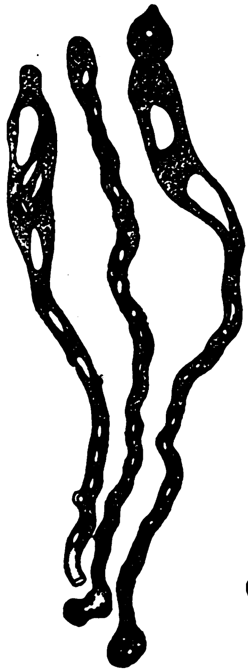


FIG. 10

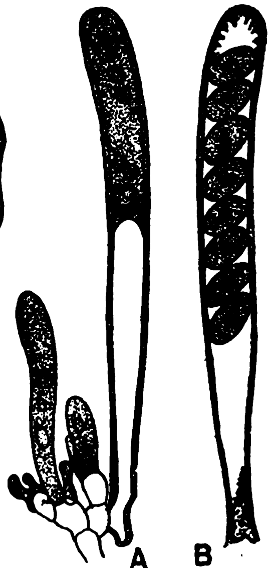


FIG. 11

FIG. 10.— *Empusa muscæ;* filaments from body of fly. Highly magnified.
FIG. 11.— A, several spore-sacs (*asci*) in different stages of development; B, a mature spore-sac. Highly magnified.

is that the spores which occur in their fruits develop in certain end cells and remain enclosed within the cell wall until matured. (Fig. 11). These spore-containing cells have been aptly likened to sacs (Latin *asci;* singular, *ascus*) and from this we derive the name of the class.

There are more species of sac fungi than of all other kinds. Their fruits range in size from very minute to many inches in extent. They include some of the most harmfully parasitic plants as well as many which live saprophytically upon refuse organic matter. Among the many families (more than 100) in this class, the following may be noticed:

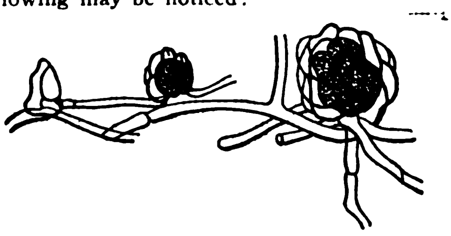


FIG. 12.— Sexual organs of *Erysiphe* and formation of fruit. Highly magnified.

Powdery Mildews (*Erysiphaceæ*) are the cause of many serious diseases of wild and cultivated plants; e.g., rose, apple, cherry, gooseberry, ash, etc. The plant body consists of branching filaments which creep over the surfaces of their hosts, from which they obtain food by means of root-like absorbing organs, which penetrate the host cells. Certain branches form spores by the simple process of separating their terminal cells in succession and this is done so abundantly that the spores form powdery masses on the surface of the hosts. These spores float away on wind currents, and those that germinate on similar hosts give rise to new plants.

The sexual organs (egg-cells and antherids) occur on the creeping filaments, and are short lateral branches, the former somewhat thicker than the slender antherids. (Fig. 12). The two come in contact with each other, and the protoplasmic contents of the antherid pass into the egg-cell fertilizing it. As a result the egg-cell sends out one or more branches, the end cells of which develop into *asci,* while from below the egg-cell there grows up a cellular, globular covering, constituting the outer wall of the fruit, and enclosing the *asci.* The spores in the *asci,* when set free by the rupture of fruit and *ascus* walls, germinate and on similar hosts give rise to new plants. These fruits are usually blackish and may be seen by the naked eye as minute globular bodies on the mass of filaments. (Fig. 13).

Truffles (*Tuberaceæ*) are eagerly sought for as table delicacies, their large subterranean fruits being highly favored by epicures. Their life history is not well known. They are saprophytic, living on the decaying organic matter in the soil in forests. Little is known as to their early life, and the formation of their non-sexual spores, but these are thought to be somewhat like those of the powdery mildews.

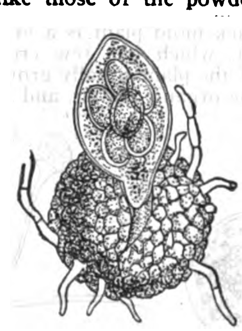


FIG. 13.— Mature fruit of powdery mildew, with escaping spore-sac. Highly magnified.

Their fruits are formed under ground. The sexual organs, which possibly precede the development of the fruits, have not yet been discovered. The fruits of the common truffles of Europe are from one to two inches in diameter, and warty and dark colored externally. (Fig. 14). Internally they consist of a soft, whitish tissue, in which are numerous cavities, each containing several *asci.* Practically nothing is known as to their propagation. A few little known species occur in America, but in Europe they are common. See TRUFFLE.

Black Fungi (*Sphæriaceæ* and numerous related families) are typically parasites which grow in the tissues of higher plants, and whose small black fruits are formed on the surface of the host. Here again we are evidently dealing with plants related to the powdery mildews, but with an increased parasitism. They are known to form non-sexual spores much as in the powdery mildews. Their fruits also resemble the fruits of the powdery mildews, and probably result from a fertilization, but thus far the sexual organs have evaded discovery.

Closely related to the foregoing and differing principally in possessing a bright color and fleshy or leathery structure are the members of the Family *Nectriaceæ*. Asexual and sexual

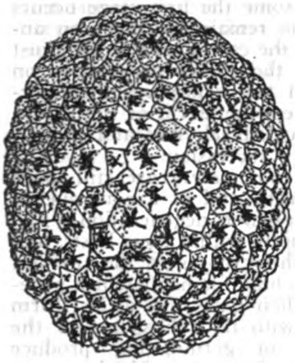


FIG. 14

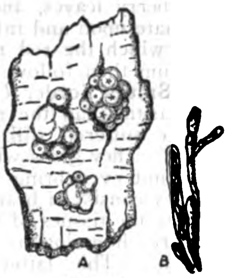


FIG. 15

FIG. 14.—Truffle; fruit, natural size.
FIG. 15.—*Nectria cinnabarina;* A, bark with enlarged fruits; B, spore-sacs. Highly magnified.

reproduction are similar to the same phenomena in the *Sphæriales*. Several species of *Nectria* (Fig. 15) cause serious cankers on apple twigs, etc. Ergot of grains (*Spermœdia* or *Claviceps*) also belongs in a closely related family.

Cup Fungi (*Pezizaceæ* and related families) are typically saprophytes (Figs. 16 and 17), growing in the tissues of decaying plants, as rotten logs, sticks, etc. In these fungi the plant is filamentous and grows through the decaying tissues as slender white, branching threads. Non-sexual spores resembling those of the powdery mildews are known for some species. Sexual organs, consisting of a globular egg-cell and a slender antherid are found on the creeping filaments. (Fig. 19). Fertilization takes

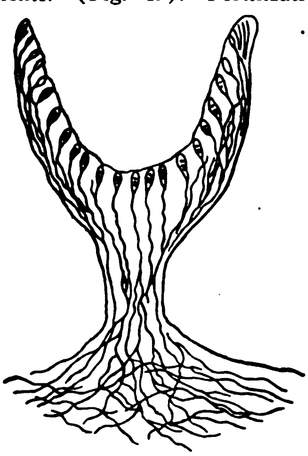


FIG. 16.—Diagrammatic vertical section of a cup fungus.

place as in powdery mildews, with a similar result, the fruits, however, being at length cup-shaped instead of globular. In many species the fruits (Fig. 17) are globular when young, but as they mature they open out into cup-shaped structures (Fig. 17), in the concave sur-

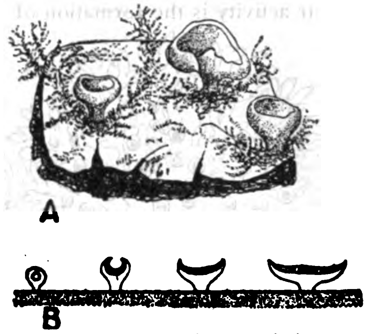


FIG. 17.—*Humaria rutilans;* A, three fruits, natural size; B, vertical sections of fruits of different ages.

face of which are found many *asci* (Fig. 18). It will readily be seen that were these cup-fruits to remain closed, their structure would be closely similar to that of the fruits of the powdery mildews or black fungi. However, the fruits of the cup fungi are often of considerable size, sometimes being as large as five or six inches in diameter.

Lichens (see article LICHENS) are now regarded as nearly related to the cup fungi and black fungi. (Fig. 20). In the essentials they agree with those fungi, but they are usually treated separately because their parasitism on various small algæ leads to the production of

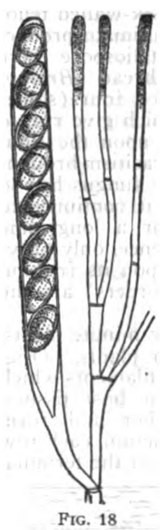


FIG. 18

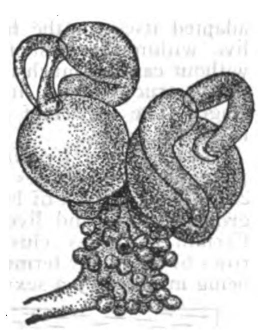


FIG. 19

FIG. 18.—*Humaria rutilans;* spore-sac, and three paraphyses. Highly magnified.
FIG. 19.—Egg-cells and antherids of a cup fungus. Highly magnified.

peculiar vegetative structures, the study of which for a long time led botanists to neglect their evident relationship to fungi which were not parasitic on algæ. There are several families of the lichen-forming fungi, aggregating between 2,500 and 3,000 species.

Yeasts (*Saccharomycetaceæ*) are here briefly referred to in order to call attention to the excessive degradation which they have suffered. Although they consist of single cells, or short chains, they are now regarded as greatly reduced sac fungi. They grow on sugars, starches and other carbohydrates, and one result of their activity is the formation of alcohol,

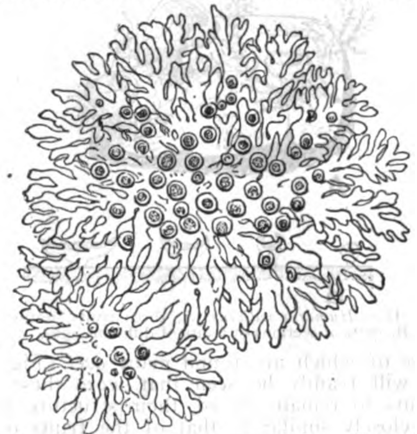


FIG. 20.—*Physcia stellaris*, a common lichen. Natural size.

while at the same time carbon dioxide is set free. It is for the alcohol that yeasts are used in breweries and distilleries, and it is for the escaping carbon dioxide gas that they are used in the making of bread. See YEAST.

Phylum Teliosporeæ.— The fungi of this phylum consist entirely of parasites upon higher plants. They are often exceedingly destructive. The characteristic distinction from the preceding phylum is the formation of a thick-walled teliospore. This is formed as the ultimate product of a sexual union. From this teliospore there arises sooner or later a short thread (*Bromycelium*) upon which are produced four (sometimes more) small "sporidia" which give rise to the new fungus when they fall upon the right host. In this phylum we find parasitism brought to its highest development. The fungus has so adapted itself to the host that it continues to live within the host tissues for a long time without causing much inconvenience, only proving destructive when it enters upon its fruiting stage. The two chief groups (orders) are the rusts and smuts.

Rusts (order *Uredinales*) are minute plants, parasitic in the tissues of higher plants. (Fig. 21). They consist of branching filaments which grow through and live upon the host tissues. Certain branches cluster together and form rows of spores by terminal abstriction, each row being initiated by a sexual union of the terminal

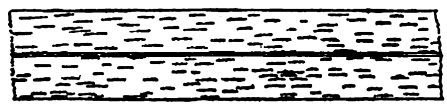


FIG. 21.— *Puccinia caricis*, a common rust on sedges.

or subterminal cells of two adjacent filaments. (*æciospores*) (Fig. 22 A). The fungus arising from the germination of these spores forms at first large numbers of red or orange colored single terminal spores (*urediniospores*) (Fig. 22 B), and still later, the one- to several-celled thick-walled, usually dark colored *teliospores*. (Fig. 22 B). These all begin within the host tissues, but they eventually break through the epidermis into the air. Lastly, when the teliospores germinate each produces a short filament (promycelium) on which four minute spores (*sporidia*) develop. There are thus four kinds of spores in a typical rust plant, and these have been taken to characterize as many stages in the plant's life history, namely: (1) Cluster-cup stage (*æciospores*); (2) Red Rust (*urediniospores*); (3) Black Rust (*teliospores*); (4) Promycelium (*sporidia*). In many rusts these stages occur on the same host in the order given, but in some the first stage occurs on one host, and the remaining stages on another. The latter is the case with the stem rust of wheat, in which the cluster-cups occur on barberry leaves, and the æciospores then germinate upon and infect the leaves of the wheat, on which the red rust, black rust and promycelium then follow in succession.

Smuts (order *Ustilaginales*) are still more parasitic than the rusts, and as a consequence have suffered still greater degeneration (Fig. 23). They grow wholly within their hosts, and do not even bring their spores to the surface. They consist of branching filaments which penetrate the tissues of their hosts, and at last form spores homologous with the teliospores of the rusts. The latter in germinating produce sporidia. Comparing the rusts with the smuts we note that while there are four stages in the

FIG. 23.— Portion of an ear of maize with eight of its kernels attacked by *Ustilago maydis*

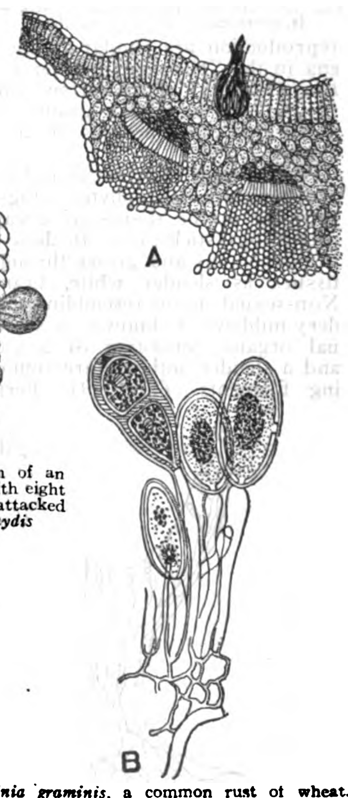


FIG. 22.— *Puccinia graminis*, a common rust of wheat. A, Cluster-cup stag on Barberry leaf; B, three urediniospores and one teliospore from a leaf of wheat. Magnified.

former, there are but two in the latter, the first and second having apparently disappeared

Imperfect Fungi.— At this point should be mentioned the so-called imperfect fungi, an immense aggregation of many thousand species (16,000 or more), of which we know but one stage (apparently the first) and so are unable to assign them to their proper place in the system. They are minute and mostly parasitic plants, occurring in the tissues of higher plants, and sending their spore-bearing branches out into the air. Some plants formerly placed here have been found to be early stages of certain sac fungi (black fungi, or their relatives) and it is suspected that most, if not all, of them will eventually be so disposed. At present they are grouped under three general kinds, as follows:

Spot Fungi (*Sphæropsidaceæ*), which produce whitish or discolored spots, and later develop closed, spheroidal cases, containing free spores. *Septoria* and *Phyllosticta* are common genera.

FIG. 24.— Basidia in different stages of development; A, when very young; B, with the spore-branches beginning to form at the summit; C, showing the spore-branches with nearly mature spores at their ends. All highly magnified.

Black-dot Fungi (*Melanconiaceæ*) are like the spot fungi, but there are no spore cases, the spores developing in masses beneath the epidermis which they eventually rupture. *Glœosporium* is a common genus.

Molds (*Moniliaceæ* and related families) produce their spores on branches which grow out through the stomata of the host. Here we find the parasitic species of *Ramularia Cercospora*, etc., and the mostly saprophytic species of *Monilia*. *Botrytis*, etc.

Basidium Fungi (class *Basidiomyceteæ*). — The distinguishing mark of this class is that the spores are produced externally upon club-shaped or rounded terminal cells. (Fig. 24). These club-shaped, spore-bearing cells are technically known as *basidia* (singular, *basidium*), whence the scientific name of the class. The basidia of this class are regarded in this discussion as the homologues of the spore-sacs (*asci*) of the preceding class.

About 14,000 species of fungi of this class are known. Many attain to considerable dimensions, especially their fruits. They are typically saprophytic, but it is now known that many of them are more or less parasitic, also, when the opportunity offers.

About 210 families are commonly recognized, four of which, only, will be noticed here.

Puff-balls (*Lycoperdaceæ*) are saprophytes whose branching filaments penetrate decaying

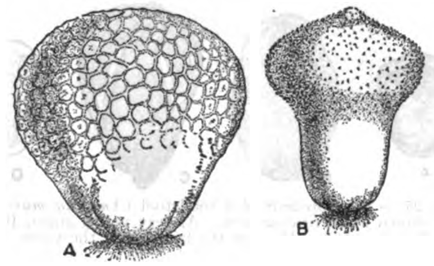


FIG. 25.— Two species of puff-balls; A, *Lycoperdon cœlatum*; B, *Lycoperdon gemmatum*.

wood or earth rich in organic matter, and finally produce globular fruits which rise above the surface. (Fig. 25), These fruits are filled with tortuous canals whose walls are studded with basidia on which the spores are produced. At maturity the interior tissues of the fruits deliquesce, setting free the spores, which escape into the air a little later as a dusty cloud, by the rupture of the fruit wall. From these spores new plants are produced, but we do not know the whole life history of these common fungi. Although the sexual organs should precede the formation of the fruits, they have not yet been observed.

Stink-horns (*Phallaceæ*) are closely related to the puff-balls, which they closely resemble in all stages excepting the last. Here the spore-bearing portion of the globular fruit is confined to a vertical, circular layer of tissue about midway between the centre and the circumference. At maturity the spore-bearing tissues deliquesce and at the same time the tissues below rapidly elongate, bursting the fruit-wall and carrying up the spores into the air. (Fig. 26). These fruits have very bad odors, which attract insects, and it is thought that these help to distribute the

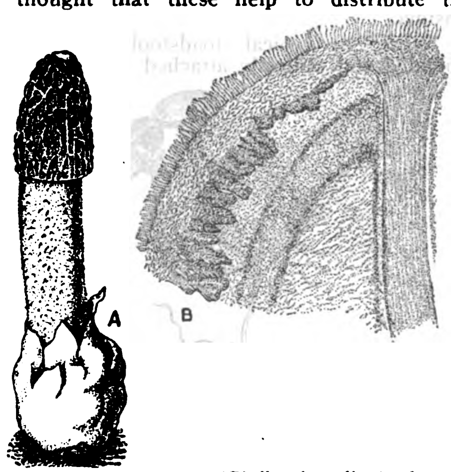


FIG. 26.— A, a stink-horn (*Phallus impudicus*) after the rupture of the volva; B, highly magnified section of the spore-bearing layer.

spores. Stink-horns are from an inch or two to six or more inches in height, and grow commonly in lawns and pastures, where their presence is indicated by their intolerable odor.

Toadstools, or **Mushrooms** (*Agaricaceæ*) are fungi of the puff-ball kind, consisting of white, branching filaments which creep through the nutriment substance or the host tissues.

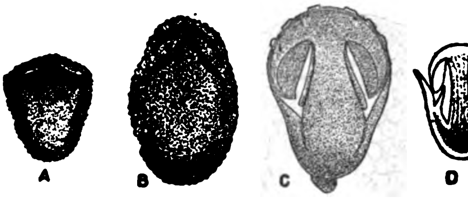


FIG. 27.— Development of a toadstool (*Amanita muscaria*) shown in vertical section. A, very young stage; B and C, later stages; D, after the bursting of the volva.

Most species are saprophytes, but some are parasites. When the fruits are young they resemble those of puff-balls, but as they grow older a circular layer of spore-bearing tissue develops, and this, by the rapid growth of lower lying tissues, is carried up on a stalk, very much as is done in the stink-horns. (Fig. 27). Here, however, the stalk is formed earlier, and the spores are usually developed after the rupture of the fruit-wall.

A typical toadstool fruit has the following structure: There is first at the bottom the cup-shaped remnant of the original fruit-wall (technically, the *volva*); from this rises the cylindrical stem (*stipe*), terminating in an expanded cap (*pileus*). The stem and cap together resemble an expanded umbrella, or a one-legged stool (Figs. 28 and 29), from which latter fact the common name "toadstool" was doubtless suggested. The lower surface of the cap is folded into many vertical radiating plates, called gills (*lamellæ*), and these are studded with the basidia, bearing the spores. This gill portion corresponds to the circular spore-bearing layer of the stink-horns, and the gills themselves are to be regarded as devices for increasing the number of spores, by an en-enlargement of the surface studded with basidia.

While in typical toadstools the cap is rounded and centrally attached to the stem, in

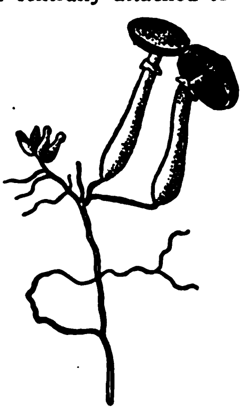


FIG. 28.— Two fruits of *Armillaria mellea* attached to the filamentous plant; several young fruits at the left. Considerably reduced.

some species its growth is not uniform, and the stalk is excentric, or even lateral. Lastly, let it be remembered that the toadstool which we see is not the plant itself (that is below the surface) but it is the fruit of the plant which develops in order that it may produce spores.

Pore Fungi (*Polyporaceæ*) are so named because the spore-bearing structure on the under side of the cap of the fruit consists of a mass of small vertical pores, instead of plates, and by this character they may be readily recognized. In typical pore fungi the general structure and development are similar to those of the toadstools, the change from gills to pores being the only important difference. Here, however, many of the species instead of growing into regular umbrella-shaped fruits have the stalk more or less laterally placed. In others, again, the lateral stalk is very short, and from this the step is a very short one to its complete suppression, when the cap is sessile marginally, as in the bracket fungi, which are

FIG. 29.— *Agaricus campestris*, the cultivated mushroom, showing several stages of development.

so common on decaying logs and other forms of timber.

Some pore fungi are fleshy, but for the most part they are hard and tough, often resisting decay for many years. Some of the species are perennial, adding successive layers of pore tissue to their fruits for some years.

ECONOMIC RELATIONS OF FUNGI.

The economic relations of the fungi are of great importance. Some are edible and furnish wholesome food to man and other animals, some are used in the arts, some yield medicines, some are the cause of disease in man and other animals, and some again attack and destroy other plants, including many of the cultivated plants of our farms and gardens.

Edible Fungi.— Here perhaps we should include those bacteria which have to do with the flavor of butter and cheese, and those molds whose presence in cheese adds to its edibility. Of far greater importance, however, are those species which are eaten for the nutriment which they contain. Truffles are collected in Europe, and sold in the markets. Dogs and pigs are trained to search for them, the attendant bagging the truffle when found by the keen scent of the animal. The Morels are sac fungi


3
5

POISONOUS FUNGI

1. Orange Chanterel (Cantharellus aurantiacus)
2. Hard-skinned Puffball (Scleroderma aurantium)
3. Green Russula (Russula furcata)
4. Emetic Russula (Russula emetica)
5. Poisonous Lactaria (Lactaria torminosa)
6. Death-cup (Amanita phalloides)
7. Thick-foot Boletus (Boletus pachypus)
8. Satan's Mushroom (Boletus satanas)
9. Antler Fungus (Calocera viscosa)
10. Fly Mushroom (Amanita muscaria)
11. Sulphur-tuft (Hypholoma fascicularа)
12. Lurid Boletus (Boletus luridus)

related closely to the cup fungi; each Morel (fruit) is a hollow-stalked body two to five inches high, with a crinkled and pitted conical cap in whose surface are embedded the spore-sacs. They grow in fields and in thickets, and when fresh are wholesome. Morels are often called mushrooms, although this name should be restricted to the next group.

Mushrooms (Fig. 29) are of the toadstool kind, and popularly but incorrectly any species which is edible is called a mushroom, while those which are poisonous are called toadstools. Many species are collected from the forests and fields by experts who have learned to distinguish them from the poisonous ones, but by far the most commonly used species is the common mushroom (*Agaricus compestris*) which is cultivated by gardeners for this purpose. See MUSHROOMS.

Poisonous Fungi.— Although the vast majority of the toadstools and other fleshy fruited fungi are edible or innocuous there are a number that are extremely poisonous and many others that, while not deadly, yet are likely to cause great discomfort or nausea. The most dangerous are the Death-cup (*Amanita phalloides*) and the Fly Mushroom (*Amanita muscaria*). The Emetic Russula (*Russula emetica*) is a common fungus that is poisonous, but its emetic nature prevents any serious injury. The occurrence of poisonous species of mushrooms makes great caution necessary on the part of those who otherwise would have in the great supply of mushrooms in the late summer and fall a source of food to be had for the picking. The only safe rule is to avoid any mushroom unless it is *known* to be harmless.

Medicinal Fungi.— The most important species is the Ergot (*Spermœdia clavus*), one of the sac fungi, which is parasitic in the heads of rye.

Pathogenic Fungi (on Animals).— Many bacteria are the direct cause of diseases of animals, including man. See BACTERIA.

Some of the water molds cause a serious disease of fishes, especially of young fishes in "hatcheries." Occasionally an epidemic, known as the "Salmon Disease," has been known to occur in the streams of Great Britain. Investigation has shown it to be due to a certain species of water mold.

The insect fungi (*Entomophthoraceæ*) annually destroy immense numbers of flies, locusts, caterpillar larvæ, etc. The common house fly is attacked by *Entomophthora muscæ* in summer and autumn. Every infected insect fastens itself by means of its tongue to some object, and soon perishes miserably, its body walls being pierced by innumerable spore-bearing branches. In the autumn myriads of locusts ("grasshoppers") are destroyed by *Entomophthora grylli*. When attacked by the fungus the locust climbs a grass or weed stem around which it finally clasps its legs and dies firmly attached. Many other insects, including mosquitoes, are destroyed by these beneficial fungi. Thus far all attempts to artificially apply these fungi in combating insects have been unsuccessful.

Several species of *Aspergillus* and other genera bring about a serious disease of the ear passages in man.

Pathogenic Fungi (on Plants). See PLANTS, DISEASES OF. See also VEGETABLE KINGDOM.

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FUNGICIDES, fŭn'jĭ-sīd, any agent used to prevent the growth of fungi or their spores. The most important uses of fungicides are in agriculture and horticulture for controlling the fungi that attack crops. These may be divided into two general classes: (1) Fungi which burrow among the tissues of the host plants and expose little more than their fruiting organs to the air. (2) Fungi which expose almost all of their vegetative parts to the air, only the holdfast, absorbing organs (*haustoria*) entering the tissues of the host. From the nature of their growth it is easily seen that members of the second group may be attacked at any time, but that since the vegetative parts of members of the first group are protected by the tissues of the host they cannot be reached effectively by any fungicide without injuring the host. Controlling agencies in such cases must therefore be preventive.

For the control of the exposed fungi the chief agent is sulphur in out-door practice, applied as a powder, which is dusted upon the foliage, preferably with a powder gun. In the greenhouse it is more frequently evaporated, by strewing powdered sulphur upon the heating pipes or upon burlap suspended in warm parts of the greenhouse. This is a slow way, and is mainly preventive. When a considerable quantity must be evaporated in a short time the sulphur is gently heated over an oil stove. It is imperative that the sulphur be kept from igniting, because the fumes are destructive to host as well as fungus. For cleansing a greenhouse of objectionable fungi when the plants are out, the sulphur may be burned and all reachable parts sprayed liberally with Bordeaux mixture.

Various compounds of copper are used as preventives of the attacks of internal feeding fungi and as remedies for the exposed. Chief of these salts is copper sulphate, which may be applied in a pure solution only to dormant wood, walls, etc. It is used at the rate of one pound to the gallon, and will, at this strength, destroy lichens and algæ as well as fungi. For use upon foliage and other actively growing parts it must be mixed with some substance which will counteract its causticity. Lime is most frequently used, and the compound is called Bordeaux mixture from the French city where its usefulness was accidentally discovered about 1882. It is made as follows: A known number of pounds of copper sulphate are dissolved in an equal number of gallons of water, contained in a wooden tank or barrel, the salt being suspended at the surface of the water to ensure quick solution. In another receptacle a known number of pounds of lime, as free from magnesium as possible, are slaked with a little water, and when slaking is complete, enough more water is added to make the proportion one pound of lime to a gallon of water. When needed for use five gallons of the copper sulphate solution and five of the lime solution are separately diluted with enough water to make a combined total of 50 gallons.

The two diluted solutions are then thoroughly mixed, and afterward tested with ferrocyanide of potash to make sure that there is no uncombined copper sulphate. A brownish discoloration indicates that more lime must be added to neutralize the free copper salt. The mixture is then ready for general use, but for peaches, plums, cherries and some other plants, another 25 gallons of water must be added because of the susceptibility of the foliage to injury. The stock solution of copper may be kept for weeks, but the lime solution should stand for only a few days and the completed mixture for only a few hours, because the particles tend to flocculate and settle, a process which impairs the usefulness of the mixture.

Copper sulphate is often used as *eau celeste,* a solution of one pound of the salt to two gallons of water, plus three half-pints of standard ammonia, and then diluted with water to make 25 gallons. Since the strength of the ammonia varies, this solution often burns the foliage, there being insufficient ammonia to neutralize the free copper sulphate. This fungicide and ammoniacal solution of copper carbonate are used when a non-staining solution is needed, as in spraying ornamental plants and fruit which is nearing maturity. The latter solution is made by dissolving one ounce of copper carbonate in one pint of ammonia and mixing with 10 gallons of water.

The seeds of various cereals are often dipped in hot water formalin solution and copper sulphate solution to destroy fungous spores, and hot water is also used to some extent for destroying exposed fungi, spores, etc.

All solutions must be applied as a mist-like spray, to ensure which a nozzle with a small aperture is essential. The first application to fruit trees should be before the buds begin to swell. This may be a stronger solution than those used after growth starts. The second should be given when the buds begin to swell, the third when the blossoms have fallen. No spray should be given during the blossoming period. A favorite fungicide for ripening fruits is the ammoniacal copper carbonate solution, made by dissolving one ounce of copper carbonate in a pint of ammonia, to which are added 10 gallons of water. Lime-sulphur solution is also an efficient fungicide. It is made by boiling fresh lime and sulphur together, or by slaking lime in contact with sulphur. It is also used as an insecticide. Sulphur is a favorite remedy for various mildews. It is dusted in the foliage with a blower, but in greenhouses is evaporated. The usual apparatus for applying fungicides to plant foliage consists of a tank or container which can be made airtight, a hose with special nozzle which produces a mist-like spray and an air pump. By means of the pump air is forced into the tank containing the liquid, which then issues under pressure at the nozzle and is converted by the latter into a spray. All types of sprayer combine the above features in one form or another. (See FUNGI; BACTERIA). Consult Lodeman, 'The Spraying of Plants' (New York 1902); Prillieu, 'Maladie des plantes agricoles' (1895); Massee, 'Text-book of Plant Diseases' (New York 1899); Duggar, 'Fungous Diseases of Plants' (New York 1909); Stevens and Hall, 'Diseases of Economic Plants' (ib. 1910); various bulletins of the United States Department of Agriculture and of many of the State Agricultural Experiment Stations.

FUNGUS, fŭn'gŭs. See FUNGI.

FUNGUS-EATERS. The fungi enter largely into the food of the lower animals, and somewhat into the fare of the higher forms. The molds, slimes and various aquatic forms are devoured by echinoderms and mollusks, both bivalves and univalves, who take in the minute floating forms, or their spores, or eat the fixed growths from stones and other resting places, and by vegetable-eating fishes and crustacea. Pond-snails will keep the glass sides of an aquarium clean of vegetable growths, a large part of which is fungoid. Worms, slugs and insects in great variety feed upon the vast array of fungi not aquatic. Beetles are especially fond of the larger forms — the toadstools and tree-borne polypores. A large Javan beetle, known from its shape as the "fiddle-beetle" (*Mormolyce phylloides*), spends its life within and about certain fungi growing on tree-trunks. A whole family of small flies (*Mycetophilidæ*) breed in fungi, including the cultivated mushroom, beds of which are often largely damaged by the work of their maggots bred there; hence the group is termed "fungus-gnats." In the United States the woodland toadstools are eagerly fed upon when ripe in August and September, not only by great numbers of insects, slugs and snails, but by salamanders, tortoises (especially) and by all sorts of squirrels; but they seem to be rarely, if ever, eaten by birds. For the edibility of fungi by man, see MUSHROOM.

FUNGUS-GNAT. See FUNGUS-EATERS; GNATS.

FUNK, Franz Xaver von, German Catholic theologian: b. Abts-Gmünd, Württemberg, 1840; d. 1907. He received his education at Tübingen and at the Rottenburg Seminary, and also at Paris, where he paid special attention to economics. He became professor of theology at the University of Tübingen in 1870 and in 1876 became a member of the editorial staff of the *Theologische Quartalschrift* there. He published 'Opera Patrum Apostolicorum' (1878; 2d ed., 1901); 'Lehrbuch der kirchengeschichte' (1886; 4th ed., 1902); 'Die apostolischen Konstitutionen' (891); 'Kirchengeschichtliche Abhandlungen und Untersuchungen' (1899).

FUNK, fŭnk, **Isaac Kauffman,** American publisher: b. Clifton, Ohio, 10 Sept. 1839; d. 1912. He was graduated at Wittenberg College, Ohio, and after several pastorates, the last of which was in Brooklyn, N. Y., began a publishing business in 1872; founded and published the *Metropolitan Pulpit* (now the *Homiletic Review*) in 1876, and the *Literary Digest* in 1890. He has published also the 'Standard Dictionary' of which he was editor-in-chief (1890–94). He was an earnest Prohibitionist, and in 1884 founded the *Voice,* a prohibition journal, and was the Prohibition candidate for mayor of New York. In 1901 he began the publication of the important 'Jewish Encyclopedia.'

FUNK, Wilhelm Heinrich, American artist: b. Hanover, Germany, 14 Jan. 1866. He was educated in the public schools of his native land, and came to the United States after his father's death in 1885. He first attracted attention by a pen-portrait of Edwin Booth, the actor. He studied at the Art Students' League, New York, and was pen and ink artist on staff of the New York *Herald* 1891–96, also contributing to *Scribner's, Century, Harper's, Judge, Truth* and other magazines of the day. During this period he went to Europe every year and studied in the galleries of Holland, Spain, Germany, Italy and France, especially the masters of the 16th century. He now devotes attention to portrait painting, and has painted portraits of several members of the royal families of Germany and England, and many well-known men and women in the United States and in France. He is an especial member of the Munich Academy of Fine Arts.

FUNNEL-MARKS, painted designs on the funnels of ocean steamships to designate the ownership of the vessel. American line steamships are thus designated by a black funnel, white band, with black top; Cunard line, red funnel, with black rings and black top; French line, red funnel with black top; White Star line, buff funnel with black top; North German Lloyd line, cream funnel; Hamburg-American line, buff for express steamers, black for regular steamers; Holland-America line, green, white, and green.

FUNSTON, Frederick, American soldier: b. New Carlisle, Ohio, 9 Nov. 1865; d. San Antonio, Tex., 19 Feb. 1917. He was educated at the State University, Kansas, and was a commissioner of the Department of Agriculture to explore Alaska 1893–94. He served in the insurgent army in Cuba in 1896–97, and was made lieutenant-colonel. Suffering from wounds and illness he attempted to reach the United States, but was taken by the Spaniards and sentenced to death. At length he was liberated and on the outbreak of the war with Spain he was commissioned as colonel of the Twentieth Kansas Volunteers. He was sent to the Philippines and in 1899 became brigadier-general of volunteers. In March 1901, he commanded an expedition which succeeded in capturing the Filipino leader, Aguinaldo, and was appointed brigadier-general in the United States army in the same month. He became commander of the department of California in 1905 and, during the earthquake and fire of April 1906, placed the city under martial law and brought order out of chaos. From December 1907 to March 1908 he was in charge of troops at the Goldfield mining centre during the great strike of that year. In May 1914, Funston was sent with troops to Vera Cruz, Mexico; he brought sanitary and hygienic perfection out of disease-breeding uncleanliness and chaos, greatly improving the healthfulness of that tropical city. In November 1914 he was made a major-general. He was appointed commander-in-chief of the army mobilized on the Mexican border in March 1916, and also of movements of United States troops in Mexico, in pursuit of the bandit, Francisco («Pancho») Villa.

FUR-BEARING ANIMALS. Those animals whose pelts are utilized as fur garments or ornaments; specifically, animals of the carnivorous family *Mustelidæ*. See MUSTELIDÆ.

FUR-BEARING ANIMALS, Cultivation of, or **FUR FARMING,** is a new and promising industry in North America, which has been begun in view of the alarming decrease of these animals in their wild state. It will relieve the pressure on the wild stock, and will make it possible not only to supply the market with the pelts of captive stock, better on the average than wild skins, but also will enable the persons engaged to supply themselves with excellent furs at a comparatively small cost. As most of the animals to be utilized are natives of cold regions the industry can be successful, according to present information, only in the colder Northern States and in Canada, as in warmer regions good long fur will not be produced; but the beaver, skunk, muskrat and raccoon may be cultivated almost anywhere when local circumstances are favorable. Farmers are most advantageously situated to carry on this industry as a side-line, so that it has come to be called «fur-farming.» Much of the food required, which is mainly such as is fed to dogs and cats, involves little expense, and the labor of attendance is light, except, perhaps, in the case of black foxes. This special line requires a considerable investment and an expensive upkeep if entered upon systematically.

The earliest serious attempts were made in Oneida County, N. Y., where minks were reared in 1866 by H. Resseque, and by others later, with profitable returns; but were not long continued. Latterly mink culture has been resumed in Canada by many persons, one company in Quebec having embarked about $50,000 in the enterprise. Minks require access to water, and the yard in which they are confined should include a small space of pond or of a running stream. They are fed on bread, corn-meal mush and the like, with fish or meat twice a week. The results thus far are highly encouraging.

The Canadian pine-marten and the larger pekan (see MARTEN) have been bred in captivity, and several serious efforts are now in progress in Canada toward their cultivation; but the difficulties of success with these animals are great. The same is true of the otter, experiments with which are being made, with good promise of success. The fur of all three is very costly, and successful cultivation would be very profitable. The raccoon is far more easily reared, and this is now done in hundreds of farm-yards, where the space required and the food supply can be furnished with almost no expense, and the returns are gratifying; but wild stock is still too abundant to make the culture of this animal very important as yet. The same may be said of the skunk. Two kinds of skunks exist in North America — the common black-and-white northern skunk, and the smaller variegated or «striped» skunk of the southwestern border and Mexico. Both produce fur that is in constant demand at good prices, the pelts of the northern skunk being now worth about $3. The skunk breeders in this country now exceed in number that of all other animals combined. This animal tames quickly and is easily managed and cheaply fed; and it offers the great advantage that it remains asleep in its den during cold weather, when other animals need the most costly attention. Any farmer or villager may easily rear a few; and there is much inducement to engage in skunk-breeding as a regular business on a large scale. In undertaking to rear these or any other animals the principle of action must be to arrange food and a manner of life for the captives as nearly as possible like that to which they are accustomed when wild.

The cultivation for its fur of the fox in captivity is the most important and extensive venture in this direction yet made. American foxes, from the point of view of the furrier, are of four kinds: (1) The gray fox of the southern United States; (2) the small swift or kit fox of the western plains; (3) the red or «common» fox, and (4) the white arctic fox. The first two have not yet been cultivated, nor do their pelts enter largely into trade. The arctic fox is yet too abundant to attract capital to its culture; but a small proportion of the species, perhaps 10 per cent, are not white even in winter, but slate-blue in color all the year round, and are known as «blue» foxes. These have been held in captivity and reared for their fur for many years at places along the shores of Alaska, and on certain islands in Bering Sea; but in most places they are able to pick up their own food (largely fish), or need be fed only a part of the year, and are caught late in the fall by trapping. Several expensive experiments have been made in establishing breeding establishments for these blue foxes in eastern Canada, and they promise well, but definite results are not at hand.

Fox-farming.— The red fox, which, in its normal fulvous condition, contributes thousands of beautiful pelts to the furriers annually, has a strong tendency toward black in its pelage. When one shows a line of black along the spine and across the withers it is called a «cross-fox»; when the dark coloring is more irregular it is a «patch-fox»; when black all over, with the tips of the hairs white, it is a «silver fox.» This last is the most valuable variety, and one which varies from grizzly to almost pure black; finally, some may be pure black. To rear in captivity the ordinary red type would not be worth the cost; but to cultivate by selective breeding the high-priced silver and black furs promised wealth. Attempts to do this began in eastern Canada more than 50 years ago, but no considerable success was reached until two independent fox-breeders in Prince Edward Island united their knowledge and stock in 1894, and began to produce black and silver foxes the sale of which, as breeding pairs, brought them great wealth, and aroused a furor of excitement and an army of more or less speculative fox-farmers. The success of these originators was owing not only to the acquired knowledge and experience of many years, but to what is now known to be a most favorable situation, and to the availability of wire-mesh for fencing. To make a fox-proof fence had been, until the invention of woven wire, a practical impossibility.

Messrs. Oulton and Dalton, operating with great secrecy, continually bred from darker and darker animals until finally they achieved silver and black strains that bred true; but it was not until 1910 that they felt justified in appearing in the market. The first 25 silver skins sent to London sold at auction for an average of $1,386 apiece. This created a furor of speculation. «People who formerly had known something of the business,» says Osgood, «were now eager to engage in it. . . . How rapidly prices for breeding-stock advanced is well illustrated by the experiences of one ranchman who sold his first pair of cubs for $750, and other pairs successively for $3,000, $12,000, $13,000 and $14,000.» The maintenance of this prodigious inflation of prices was due mainly to stock companies which sprang up like mushrooms and were capitalized so recklessly that in May 1913, when the value of the foxes on Prince Edward Island was estimated officially at $15,000,000, the combined capitalization of 196 registered companies was $29,305,700, and in December 1914 was $31,500,000. In addition to this fox «ranches» were established all over Canada, and in almost every one of our northern tier of States. Then the monopoly was broken. Wild stock was searched for and found in increased amount, the war came on, and the inflation collapsed. Ranch-bred silver foxes could soon be bought for $1,500 to $2,000, or often much less, and pelts fell in price to the level of 10 years ago. «Now, with a comparatively large number of silver foxes in domestication, with a clearer understanding of their successful management, and with a return of moderate prices for breeders, a steady, healthy and general development of silver-fox farming may be expected.»

Karakul.— A very different kind of domestication of animals for the production of fur is that of the Central-Asian sheep, known as karakul (Black Lake), whose lambs at birth are clothed in a coat of closely curled black hair, formerly designated astrakan or Persian lamb. Some of these sheep (known as Arabi, Krimmer, broadtail, etc.) were imported, at great trouble and expense, in 1908 and their progeny, crossed with other breeds, is now producing these valuable lamb-skins here and in Canada. The industry is experimental as yet, but seems likely to prove a very valuable success. Consult Ingersoll, E., 'Animal Competitors' (New York 1911); Jones, J. W., 'Fur Farming in Canada' (Montreal 1913); Circular on Karakul Sheep (Department of Agriculture, Washington 1913); Dearborn, Ned, 'The Domesticated Silver Fox' (Department of Agriculture, Farmers' Bulletin 795, Washington 1917, which summarizes Farmers' Bulletins 301 and 328 previously issued).

ERNEST INGERSOLL.

FUR SEAL, the fur-bear or northern fur-seal (*Otaria ursina*), whose pelts form the seal-skins of commerce. (See FUR TRADE). There is also a southern fur-seal (*O. nigrescens*), dwelling along the southern coast of South America. See SEAL.

FUR TRADE, The. The history of the fur trade is so closely interwoven with the early history of America that it is extremely difficult to narrate one without reference to the other. Among all the industries that helped to make this country one of the great commercial nations of the world none exerted such an important influence upon the early prosperity of the colonies as that represented by those who took the pelts of animals and prepared them for manufacture into various articles for the use of mankind. The rich peltries of North America attracted hardy French and British adventurers to the shores of the New World, and to obtain furs they journeyed into the most distant and inaccessible parts of the land; and that


SEA LION
POLAR BEAR
ARCTIC FOX
SEAL
OPOSSUM
ERMINE
BADGER
MARTEN
SKUNK
MUSKRAT
SABLE

FUR-BEARIN

ANIMALS

they might have havens of safety in which to store their pelts, and, incidentally, rest secure from the attack of a savage foe, they established small settlements, so many of which have since grown into prosperous communities. It was the fur trader, therefore, who was the real pioneer in North America. Always in advance of civilization, his labors in leading the way for the settlement of the country provided a means of advancement that would have been much delayed if it had not been for these preparatory efforts. The Canadian provinces, for example, owed practically all their primary prosperity to their fur trade, for in Canada, as throughout the English colonies farther south the native Indians were so ignorant of the value of the pelts which they gathered that they were willing to dispose of them upon terms that permitted an enormous profit to the successful trader.

Era of Great Fur Companies.— The conditions under which the fur trade with the natives was conducted soon became such a serious scandal that the licensing system was introduced, but this too soon became subject to abuse.

It was during these early days that the feuds between the British merchants of New York and the Canadian (French) traders became a serious factor in the industry. There can be little doubt that the former set out deliberately to encroach upon the fur interests of Canada, and the infringement of territorial rights had become serious when the Hudson's Bay Company was formed in 1670. This British company, which was chartered by Charles II, had the exclusive privilege of planting trading stations on the shores of Hudson Bay and all its tributaries, and when, about a century later, France lost possession of her Canadian colonies, the Britons assumed almost exclusive control over the great fur trade of America. Prior to the beginning of the 19th century this trade was chiefly monopolized by the powerful trading companies.

First in the field, of course, was the Dutch West India Company, with its prosperous trading-posts at New Amsterdam (now New York), Beaverwyck (now Albany), and at several points on the Delaware. Next came the extensive Hudson's Bay Company, which practically monopolized the trade in furs for 200 years, or until the Northwest Company entered the field and established a somewhat successful rivalry, although its efforts were confined almost entirely to the Pacific coast. This was an organization of French-Canadian merchants, and was formed in 1784 under the name «Compagnie du Nord-Ouest.»

It was in 1808 that John Jacob Astor formed the American Fur Company, establishing a line of trading-posts that extended across the continent, with a depot for furs at the mouth of the Columbia River, from which point he intended to ship direct to China and India. The name of the concern was afterward changed to the Pacific Fur Company and Mr. Astor saw his enterprise on the high road to success, when, in 1813, he was treacherously sold out to the Northwest Company by his resident partner, the latter claiming that, as the United States was then at war with Great Britain, the British soldiers would have taken the establishment by force if he had not made other disposition of it. After this incident, Mr. Astor confined his operations to the district east of the Rocky Mountains, where he, with his partner and successor, Ramsay Crooks, transacted a profitable business in furs for many years. The Russian-American Fur Company, which had its main trading-post at Sitka, Alaska, with many subordinate posts on the Yukon, carried on an immense traffic in such lines until 1867, when all its rights and properties were transferred to the United States with the purchase of Alaska.

Astor's Enterprises.— It was somewhat prior to 1809 that John Jacob Astor conceived his great project to make the American fur trade independent of the Hudson's Bay Company. As his scheme was partly based upon the fact that such an enterprise would have a strong tendency to spread the civilization of the East into the far western country, he asked the aid of Congress in carrying it into execution. Mr. Astor's idea was to establish a connected chain of trading-posts from the Great Lakes to the Pacific Ocean, with a central depot for packing and shipment at the mouth of the Columbia River; to acquire one of the Sandwich Islands as a provision station and to establish a line of vessels to sail from the west coast of North America to the most important ports in India and China. Washington Irving, in his 'Astoria,' presents a graphic description of this gigantic enterprise which met with such a strange disaster when Astoria, the town founded at the mouth of the Columbia River in 1811, was so unnecessarily abandoned during the War of 1812. The remainder of Mr. Astor's career, however, was quite as remarkable. Year after year his fur business was extended until its operations surpassed those of any house that had hitherto been established. In addition to its immense American business a gigantic export trade was carried on with many countries, and, when the founder of the company died, he left a fortune that was estimated at $20,000,000. William Backhouse Astor, his son, was interested with him in the fur trade, and when, in 1827, the house of John Jacob Astor & Son was merged in the American Fur Company, he became its president.

Later Developments.—The first great establishment founded in Saint Louis — one of the principal depots of the fur trade from the middle of the 18th century until 1859 — was that of Laclede, Maxon & Company, in 1763. In the early days of this house the brothers Auguste and Pierre Chouteau were connected with it, and the establishment, which was extremely successful, employed a large number of trappers and voyageurs. In 1808, the Chouteau brothers and a number of their associates in the older firm withdrew to form the Missouri Fur Company. This prospered until about 1813, when, because of the war with Great Britain, it was dissolved. During the next few years several of its members transacted business independently, but, in 1827, the Rocky Mountain Fur Company of Saint Louis was formed to send trappers to the Pacific coast. At this time the perils of the work were so great that fully 40 out of every 100 persons employed in it perished, and yet the life of adventure offered so many fascinations that there was no lack of hardy men eager to take the places of the slain. After several years of varying success the company was dissolved. In 1834, however, Pierre Chouteau, Jr., who had been educated in the fur trade by his father, organized the house of Pierre Chouteau, Jr. & Company, a firm name which was a household word among hunters and trappers during the next 25 years. In 1859, the business was sold to Martin Bates and Francis Bates of Saint Louis and New York.

The table that follows is designed to present a list of the principal fur-bearers of the world, their habitat and their average yield during the 30 years previous to the opening of the European War which has wrought far-reaching disturbance in this trade, but will benefit the animals, especially in Russia. The authority is the fur statistician, Emil Brass, of Leipzig.

The year 1859 saw the American fur trade more widely diffused than ever before. The

NAME OF ANIMAL	Explanations	Habitat — Source of raw fur	Average annual supply, 1900–1913
Badger	Several species	N. America, 30,000; Europe and Asia, 130,000	150,000
Bear, black	*Ursus americanus*	North America	20,000
Bear, brown	Several species	N. America, 2,000; Asia and Europe, 12,000	14,000
Bear, grizzly	*Ursus horribilis*	North America	1,200
Bear, white	Polar bear (*U. maritimus*)	Polar regions	1,000
Cat, domestic	Common house cats	N. America, 80,000; Europe, chiefly Holland and Russia, 770,000; Asia, 150,000	1,000,000
Cat, wild	Various species, not lynx	See WILD CAT.	
Civet-cat	Cacomistle (*Bassarisius astutus*)	S. W. United States; Mexico	160,000
Chinchilla	Three related rodents	Peru, Chile, Bolivia	40,600
Coney	See RABBIT.		
Ermine	Any weasel in white winter coat	N. America, 400,000; Siberia, 700,000; Europe, 10,000	1,110,000
Fisher or Pekan	Black cat.		
Fitchew	The polecat: strictly, its fur	European	....
Fox, black	Variety of red fox	Rare and extremely costly	....
Fox, blue	Blue variety of white fox	Polar regions, especially Alaska	11,000
Fox, cross	Variety of red fox	North America	15,000
Fox, gray	*Uracyon cinereo-argenteus*	North America	50,000
Fox, Japan	Raccoon-dog (*Nyctereutes procyonides*)	China, Japan, Korea	260,000
Fox, karganer	....	Central Asia	150,000
Fox, kit	Small species of open plains	N. America, 4,000; Central Asia, 60,000	64,000
Fox, pampas	Several Patagonian fox-wolves	Argentina	15,000
Fox, silver	Variety of red fox	North America, 4,000; Siberia, 300	4,300
Fox, white	Arctic fox (*Vulpes lagopus*)	Alaska and polar regions	105,000
Fur seal	*Otaria ursina*	Bering sea	68,000
Hamster	*Cricetus frumentarius*	Germany, 2,000,000; Austria, 250,000	2,250,000
Hare, polar	Several northern, winter-white species	N. America, 200,000; Siberia, 5,000,000	5,200,000
Karakul	See LAMBSKINS.		
Kolinsky	Siberian polecat; also similar skins	Siberia, etc., 200,000; China, 500,000; Japan, 200,000	900,000
Lambskins	Newly-born lambs of Asiatic sheep	Persia, Turkestan, southern Russia	2,860,000
Lynx	American and Old World lynxes	N. America, 90,000; Europe and Asia, 40,000	130,000
Marmot	Woodchucks and other ground-squirrels	N. America, 30,000; Asia, 4,550,000	4,580,000
Marten	Three Old World species, except sable	Europe, 530,000; N. Asia, 60,000	590,000
Marten, Hudson Bay	Pine marten (*Mustela Americana*)	North America	120,000
Mink	*Putorius vison*, and other species	North America, 600,000; North Asia, 60,000	660,000
Mole	Old World species	Europe and Asia	1,000,000
Muskrat	Musquash (*Fiber sibethicus*)	North America	8,000,000
Nutria	(*Myopotamus coypu*). Coypu; Otter	Northern South America	5,000
Opossum	American (*Didelphys virginiana*)	Southern United States	1,000,000
Opossum	Australian, several marsupials	Australia and New Guinea	4,000,000
Ocelot	Leopard cat (*Felis pardalis*)	(Included in WILDCAT)	....
Otter	*Lutra canadensis*	North America, 30,000; Asia and Europe 86,000	116,000
Polecat	*Putorius fœtidus:* Fitch	Europe and Siberia	290,000
Rabbit	The European Coney (*Lepus cuniculus*)	France and Belgium, 50,000,000; Germany and Russia, 1,000,000; Australia, 20,000,000	71,000,000
Raccoon	*Procyon lotor*	North America	600,000
Raccoon-Dog	See FOX, JAPAN.		
Sable	Mustela zibellina	Siberia, 70,000; China, 20,000; Japan, 5,000	95,000
Skunk	*Mephitis mephitica*	North America, 1,500,000; South America, 5,000	1,505,000
Squirrels	Several Old World species	Siberia, 15,000,000; China, 500,000 (Also 75 tons of squirrel-tails).	15,500,000
Weasel	See ERMINE; KOLINSKY (Chinese).		
Wildcat	Common European Wildcat, and others	Asia and Europe, 50,000; South America, 10,000	60,000
Wolf, gray	Several species	North America, 8,000; Russia and Asia, 22,000	30,000
Wolf, prairie	Coyote	North America	40,000
Wolverine	Glutton; carcajon	North America, 3,000; Europe and Asia, 5,000	8,000
Total (1909)			*123,213,100

* There is good reason to estimate that by June of 1914 this total had been increased to 130,000,000 skins. Only those are counted that pass through the world's auction markets, where the total cash value realized by the sellers of this raw material is probably not less than $100,000,000 annually.

passage of the industry into the hands of individuals had commenced to be apparent as early as 1821, and while, by the middle of the century, the aggregate amount collected each year was much greater than it had been 40 years previously, the opportunities for making great fortunes in the trade had gone. A writer in *Silliman's Journal* (1834) gives an interesting description of the situation of the fur trade at that time. He says:

«The Northwest Company did not long enjoy the sway they had acquired over the trading regions of the Columbia. A competition, ruinous in its expenses, which had long existed between them and the Hudson's Bay Company, ended in their downfall and the ruin of most of the partners. The relict of the company became merged in the rival association, and the whole business was conducted under the name of the Hudson's Bay Company. This coalition took place in 1821. Almost all the American furs which do not belong to the Hudson's Bay Company find their way to New York and are either distributed thence for home consumption or sent to foreign markets. The Hudson's Bay Company ship their furs from their factories of York Fort and from Moose River, on Hudson Bay; their collection from Grand River, etc., they ship from Canada; and the collection from Canada goes to London. None of their furs come to the United States, except through the Indian market. The export trade of furs from the United States is chiefly to London. A quantity of beaver, otter, etc., is brought annually from Santa Fe. Dressed furs for edgings, linings, caps, muffs, etc., such as squirrel, genet, fitchskins, and blue rabbit, are received from the north of Europe; also cony and hare's fur; but the largest importations are from London, where is concentrated nearly the whole of the North American fur trade.»

As early as 1834 those who were interested in this industry began to fear that the American fur trade had commenced to decline and, even at that time, it was quite freely predicted that its downfall would be rapid. By this period there were practically no new lands to be explored. The hunters and trappers in the employ of the great fur-trading companies had gone everywhere and had slaughtered so indiscriminately that it seemed almost impossible that the fur-bearing animals should not be exterminated. It is true that now the buffalo and large deer, the bears and the puma and the otter, beaver and pekan are gone or become rare so far as their interest to the trade is concerned, but the smaller, and on the whole, more important fur-bearers, are about as numerous as ever, several kinds maintaining their numbers in the very midst of civilization, as does the muskrat, mink and skunk. As a matter of fact the yield of American pelts in early times was far less a year than recently. Take the muskrat, for example. The average number of skins sold on the London market between 1800 and 1850 was about 411,000; from 1850 to 1900 it was more than 2,500,000. In recent years the London sales were: 1911, 5,197,530; 1912, 5,014,921; 1913, 6,876,417; 1914, 10,488,647. In addition to this an enormous number of skins was used from year to year in the United States and Canada. The average sales of skunks increased in the same way. In 1858 London disposed of 18,255 skins; in 1878, 285,103; in 1898, 482,130; in 1908, 1,037,641; in 1909, 1,115,910; in 1910, 1,282,000; in 1911, 2,009,465; in 1912, 1,821,485; in 1913, 1,659,773. The persistence of these two, and other animals, against such a warfare is largely due to the laws that now protect them except during the breeding-season. Nevertheless the finest fur-bearers, such as the sable, marten, sea-otter and silver fox have rapidly decreased in the present century.

Consult files of the *Fur Trade Review*, *Fur News Magazine* and the publications of the United States Department of Commerce and Labor, especially the consular and trade reports; also of the Canadian Commission of Conservation.

ERNEST INGERSOLL.

FÜRBRINGER, für'bring-ẹr, **Max Karl**, German anatomist: b. Wittenberg 1846. He received his education at the universities of Jena and Berlin; was appointed professor at the former institution in 1888 and at the University of Heidelberg in 1901. His works have been noteworthy contributions in their special field; they include 'Die Knochen und Muckeln der Extremitäten bei den schlangenähnlichen Saurien' (1870); 'Zur vergleichenden Anatomie der Schultermuskeln und des Brustschulter apparatus' (5 parts, 1872–1902); 'Zur Entwicklung der Amphibiennière' (1877); 'Untersuchungen zur Morphologie und Systematik der Vögel' (1888); 'Morphologische Streitfragen' (1902); 'Abstammung der Säugetiere' (1905).

FURETIÈRE, fü-rẹ-tyār, **Antoine**, French lexicographer and litterateur: b. Paris 1619; d. there 1688. He studied law at first, followed the profession of advocate and became fiscal procurator of the Abbaye de Saint-Germain. Later he became abbé of Chalivay and prior of Pruines. In 1655 he published a volume of 'Poésias diverses'; in 1658 the 'Nouvelle allégorique ou Histoire des derniers troubles arrivés au royaume d'éloquence'; 'Voyage de Mercure' (1659); the two last-named secured his admission to the Academy in 1662. Later from his pen appeared 'Fables' and 'Le Roman bourgeois,' in which he depicted with extraordinary realism the manners of Paris in 1666. About this time he became intimate with Racine, Boileau, Molière and La Fontaine; with whom he collaborated in 'Le Chapelain décoiffe.' Furetière was one of the greatest satirists of his age and also the most learned. For over 40 years he labored on a 'Dictionnaire universel,' for which in 1684 he had obtained the royal privilege. It did not appear until 1690 at Rotterdam, two years after the author's death. The Academy, which for many years had in preparation a dictionary of its own, was greatly opposed to Furetière's project and in 1685 brought about his deposition from the Academy. His dictionary had many special merits and served as a basis for the 'Dictionnaire de Trévoux. Consult Gosse, 'The Romance of a Dictionary' (in New York *Independent*, 1901) and Chatelain (in *Revue Universitaire*, Paris 1902).

FURIES, EUMENIDES, or ERINYES, called by the Romans FURIÆ and DIRÆ, were Greek mythological divinities, the avengers of murder, perjury and filial ingratitude. They sprang from the drops of blood which fell from Uranus when he was mutilated by his son Kronos or Saturn. Others make them the daughters of Acheron and Night, and of Pluto and Proserpine. Later mythologists reckon three of them and call them Alecto the unresting, Megæra the jealous, and Tisiphone the avenger. They were supposed to be the ministers of the gods and to execute their irrevocable decrees; their sphere of action consequently was both in the infernal regions, to punish condemned souls, and on the earth to rack the guilty conscience and chastise by mental torments. Æschylus, in the celebrated tragedy of the Eumenides, introduced 50 furies, and with them Horror, Terror, Paleness, Rage and Death upon the stage. These terrible beings were described as clothed in black robes, with serpents instead of hair, with fingers like claws, a whip of scorpions in one hand and a burning torch in the other, an outstretched tongue and eyes dripping with gore. They were suckers of the blood of men; when they were enraged, a venom oozed from them that spread like a leprosy-spot wherever it fell and made the ground barren. They were regarded with great dread and the Athenians hardly dared to speak their names, but called them the *venerable goddesses,* by a similar euphemism the name Eumenides, signifying the soothed or well-pleased goddesses, being introduced. They dwelt in the cave called after them, at the northeast corner of the Areopagus at Athens, below the seats of the judges. Erinyes, the more ancient name, signifies the hunters or persecutors of the criminal, or the angry goddesses. The sculptors represented them as beautiful hunting nymphs, whose character was indicated only by the sternness of their expression, by the torch, dagger and other similar emblems.

FURIUS, Marcus Furius Bibaculus, Roman poet: b. Cremona 103 B.C.; date of death unknown. He is classed by Quintilian along with Catullus and Horace as one of the most distinguished of the Roman satiric iambographers. From the scanty and unimportant specimens of his works transmitted to modern times, we are scarcely in a condition to form any estimate of his powers. A single senarian is quoted by Suetonius, containing an allusion to the loss of memory sustained in old age by the famous Orbilius Pupillus; and the same author has preserved two short epigrams, not remarkable for good taste or good feeling, in which Furius sneers at the poverty to which his friend, Valerius Cato, had been reduced at the close of life, as contrasted with the splendor of the villa which he had once possessed. It seems certain that he published a poem on the Gallic wars, entitled 'Pragmatia Belli Gallici.' This is known to us only from a metaphor parodied by Horace, who ridicules the obesity which distinguished Furius. Consult Bährens, 'Fragmenta Poetarum Romanorum' (Leipzig 1886); Schang, 'Geschichte der Römischen Litteratur' (3d ed., Munich 1907); Weichert, 'Poetarum Latinorum Fragmenta'; id., 'Dissertatio de Turgido Alpino S. M. F. Bibaculo' (Meissen 1882).

FURLOUGH, the absence, with leave, of enlisted men. In the United States army the post or regimental commander may grant furloughs not to exceed one month in duration, the brigade commander for two months, the division or department commanders for three months, and the Secretary of War for longer periods, in case of necessity. Not to exceed 5 per cent of any command may be absent on furlough at any one time. Soldiers on furlough are entitled to pay, and to commutation of rations at the rate of 25 cents per diem. Consult latest edition of 'United States Army Regulations.'

FURMAN, Richard, American Baptist clergyman: b. Esopus, N. Y., 1755; d. Charleston, S. C., August 1825. While he was an infant his father removed to Sumter district, S. C. His education, though obtained irregularly, became considerable, including a knowledge of Latin, Greek and Hebrew. He was converted at an early age, and soon began to preach, and at 19 was ordained pastor of the High Hills Baptist Church. On one occasion he was not allowed by the sheriff to preach in the courthouse at Camden because he was not a member of the established (Episcopal) church. At the beginning of the Revolution he actively promoted measures for removing the disabilities under which the Dissenters labored. During that struggle he became so conspicuous as a patriot that Lord Cornwallis offered a reward for his apprehension, and after a while he retired to Virginia, where Patrick Henry was a regular attendant on his ministry. In 1787 he became pastor of the First Baptist Church in Charleston, S. C., in which relation he continued for 37 years. He was a member of the convention that framed the first constitution of South Carolina, and vigorously opposed in that body the provision which excluded ministers from certain offices. In 1814 he was elected first president of the Triennial Convention of Baptists, and for several years was president of the South Carolina Baptist Convention. He published several sermons and addresses, including one commemorative of George Washington. Furman University at Greenville, S. C., was named in his honor. Consult Sommer, 'Memoir of John Stanford' (New York 1835).

FURMAN UNIVERSITY, a coeducational institution in Greenville, S. C., founded in 1854 under the ausipces of the Baptist Church. Reported in 1916: Professors and instructors, 16; students, 276; volumes in the library, 8,000.

FURNACE, an apparatus wherein a vehement fire and heat may be made and maintained, as for melting glass, ores or metals, heating the boiler of a steam-engine, warming a house, firing pottery or baking bread and other such purposes. Furnaces are constructed in a great variety of ways, according to the different purposes to which they are applied. In planning furnaces the following objects are kept in view: (1) To obtain the greatest quantity of heat from a given quantity of fuel. (See FUEL). (2) To prevent the dissipation of the heat after it is produced. (3) To concentrate the heat and direct it as much as possible to the substances to be acted on. (4) To be able to regulate at pleasure the necessary degree of heat (see HEAT) and have it wholly under the operator's management.

The materials of which a furnace is constructed must be able to endure wide variations of temperature as well as the highest degree to which it may be subjected, without losing their physical or chemical constitution. Such materials are called "refractories" (q.v.).

Furnaces are hand-fired when the fuel is added from time to time by hand. There are two types of mechanical stokers — underfeed and overfeed. The former employs a steam ram which forces the fuel up from below, and is used generally in connection with forced draught: the overfeed type employs a grate which moves horizontally from the front of the furnace toward the rear, the fuel being fed from a hopper on to the front end, and the ashes and cinders passing off at the rear. The grate resembles an endless chain. The Murphy furnace has a V-shaped cross-section, with feeders along each side, at the top of the V, the grates forming the sides of the V. At the bottom is a shaft which may be revolved to remove the ashes.

In all furnace construction the effort is made to secure smokeless combustion, and many smoke-consuming devices have been invented. Most of these have been unsatisfactory, and in any event the formation of smoke in the first place shows that the problems of economical combustion have not been solved. One of the improvements has been the admission of air above the fire through the fire-door, which supplies oxygen for the consumption of the unburned gas. Steam jets have been tried for the same purpose, but their disadvantages overbalance the gains. The indirect-fired furnace, which has a separate chamber for the fire, obviates the smoke difficulty to a large extent, and, by using the chimney gases to heat the air admitted to the fire chamber, a higher degree of working heat is secured.

An air furnace is one in which the flames are urged only by the natural draught of the chimney; a blast furnace, one in which the heat is intensified by the injection of a strong current of air by artificial means; a reverberatory furnace, one in which the flames in passing to the chimney are thrown down by a low-arched roof on the objects which it is intended to expose to their action. A gas furnace is one in which gas is used for fuel.

The gas to be consumed and the air to be used in the combustion are introduced into the combustion-chamber by separate pipes or openings, preferably in parallel streams near to each other, or in opposite directions along one channel so as to mingle before entering the chamber. The fuel may be either natural gas, or what is called «producer gas» specially manufactured for the purpose; or it may be the by-product of some other industrial process, for example, the waste gases of the blast furnace. Regenerators are furnaces in which the gaseous fuel and the air to be mixed with it are heated before combustion with a view to increasing the working temperature of the furnace. The advantages of gas furnaces may be briefly summarized thus: no ashes or slag, high temperature, certainty of action and capability of exact regulation, simplification of working power, comparative cheapness and economy. The electric furnace utilizes the electric current to produce the highest temperatures used in the arts. (See COMBUSTION; ELECTRIC FURNACE; HEATING; GAS; GAS, NATURAL). Consult Clark, T. M., 'The Care of a House' (New York 1912); Damour, E., 'Industrial Furnaces' (New York 1906); Havard, F. J., 'Refractories and Furnaces' (New York 1912); Hays, J. W., 'Combustion and Smokeless Furnaces' (Chicago 1915); Peebles, J. C., 'Furnace Efficiency' (Chicago 1914).

FURNACES, Electric. See ELECTRIC FURNACES.

FURNACES, Metallurgical. See METALLURGY.

FURNEAUX, fur-no', **Tobias**, English navigator: b. Swilly, Plymouth, 21 Aug. 1735; d. there, 19 Sept. 1781. Entering the royal navy he saw active service in the latter part of the Seven Years' War, 1760–63. In 1766–68 he was second lieutenant to Captain Wallis of the *Dolphin* in a voyage around the globe. He commanded the *Adventure* which accompanied Captain Cook in his second voyage of discovery. On this voyage from February to May 1773 he was separated from Cook and again from October 1773 to July 1774. He pursued the objects of the expedition, however, and made the first British chart of the coasts of Tasmania where much of the nomenclature given by him survives. Cook named the islands in Bank Straits after Furneaux, also a group now known as the Low Archipelago. In 1775 Furneaux became a captain and on 28 June 1776 commanded the *Syren* in the attack on Charleston, S. C. Consult the life by Rev. Henry Furneaux (in 'Dictionary of Natural Biography').

FURNEAUX ISLANDS, a group in the South Pacific off Tasmania, to which colony they belong. The total area is about 1,050 square miles. The principal islands are Flinders, Cape Barren and Clarke. The inhabitants number about 700, and earn their livelihood by seal-fishing, the capture of sea-fowl, etc. The islands were discovered in 1733 by Tobias Furneaux (q.v.).

FURNESS, SIR **Christopher,** English ship builder and ship owner, 1ST BARON: b. West Hartlepool, 23 April 1852; d. Ripon, 10 Nov. 1912. The son of a farm laborer who became a corn merchant, he achieved his first success for the firm by shipping flour from Sweden during the Franco-German War.. In 1874 he founded the «Furness» line of steamships, which now owns nearly 100 steamers, with a total tonnage of close on 300,000 tons. He also established the great ship-building firm of Furness, Withy and Company, Hartlepool, in connection with which in 1909 he set on foot a profit-sharing scheme, which, however, was abandoned two years later at the request of the unskilled workers. He represented Hartlepool in the Liberal interest 1891–95 and 1900–10. He was knighted in 1895, and raised to the peerage in 1910.

FURNESS, Horace Howard, American Shakespearian scholar and editor; son of William Henry Furness (1802–96) (q.v.): b. Philadelphia, 2 Nov. 1833; d. 13 Aug. 1912. He was graduated at Harvard in 1854; studied law, and was admitted to the bar in 1859. The honorary degree of Ph.D. was conferred on him by the University of Göttingen in recognition of his services to Shakespearian literature. He is the editor of the exhaustive 'New Variorum Edition' of Shakespeare, the successive volumes of which appearing since 1871 include 'Romeo and Juliet' (1871); 'Macbeth' (1873); 'Hamlet' (2 vols., 1877); 'Lear' (1880); 'Othello' (1886); 'Merchant of Venice' (1888); 'As

You Like It' (1890); 'Tempest' (1892); 'Midsummer Night's Dream' (1895); 'Winter's Tale' (1898); 'Twelfth Night' (1901); 'Love's Labor Lost' (1904); 'Antony and Cleopatra' (1907), and 'Cymbeline' (1913). He was aided in his editorial work by his wife and his son. He received honorary degrees from Columbia, Harvard and Yale, and was a member of the American Academy of Arts and Letters. The 'Variorum Edition' is most exhaustive, being practically the last work on the text of Shakespeare. Consult 'Appreciations of Horace Howard Furness' (1912).

FURNESS, William Henry, American clergyman and author: b. Boston, Mass., 20 April 1802; d. Philadelphia, 30 Jan. 1896. He was educated at Harvard; studied theology at Cambridge, Mass., and was pastor of the First Unitarian Church in Philadelphia in 1825–75. He was an earnest supporter of the anti-slavery movement and was a German scholar of eminence, translating much from the German in both prose and verse. He was radical in his religious views but made a life study of the character of Jesus, which forms the theme of several of his works. Among his numerous works are 'Remarks on the Four Gospels' (1836); 'Jesus and His Biographers' (1839); 'A History of Jesus' (1850); 'Thoughts on the Life and Character of Jesus of Nazareth' (1859); 'The Veil Partly Lifted' (1864); 'Jesus' (1871); 'Verses and Translations from the German Poets' (1886); 'Pastoral Offices' (1893).

FURNESS, William Henry, American artist, son of the preceding: b. Philadelphia, Pa., 21 May 1828; d. Cambridge, Mass., 4 March 1867. He very early made a reputation by the excellence of his crayon portraits, and having earned from the sale of these the means for foreign travel, studied art in Europe for two years. On his return to America he established himself as a portrait painter in Philadelphia, and subsequently in Boston, and at the time of his death was one of the foremost portrait painters in the country. Among noted portraits by him are those of his father, Dr. Furness; Charles Sumner and Lucretia Mott.

FURNESS, William Henry, American ethnologist: b. Wallingford, Pa., 18 Aug. 1866. He is a son of Horace H. Furness (q.v.), and in 1888 was graduated at Harvard University, subsequently graduating at the medical school of the University of Pennsylvania. He made scientific tours in South America and elsewhere, the results of which are embodied in several volumes from his pen. In 1904 he became secretary and curator of the Free Museum of Science and Arts of the University of Pennsylvania. He is a fellow of the Royal Geographical Society. His works include 'Folklore in Borneo' (1899); 'Life in the Fuchu Islands' (1899); 'Home Life of the Borneo Head Hunters, its Festivals and Folklore' (1902); 'Uap, the Island of Stone Money' (1910), also several monographs to the American Philosophical Society. In April 1917 he was commissioned captain in the Medical Reserve Corps.

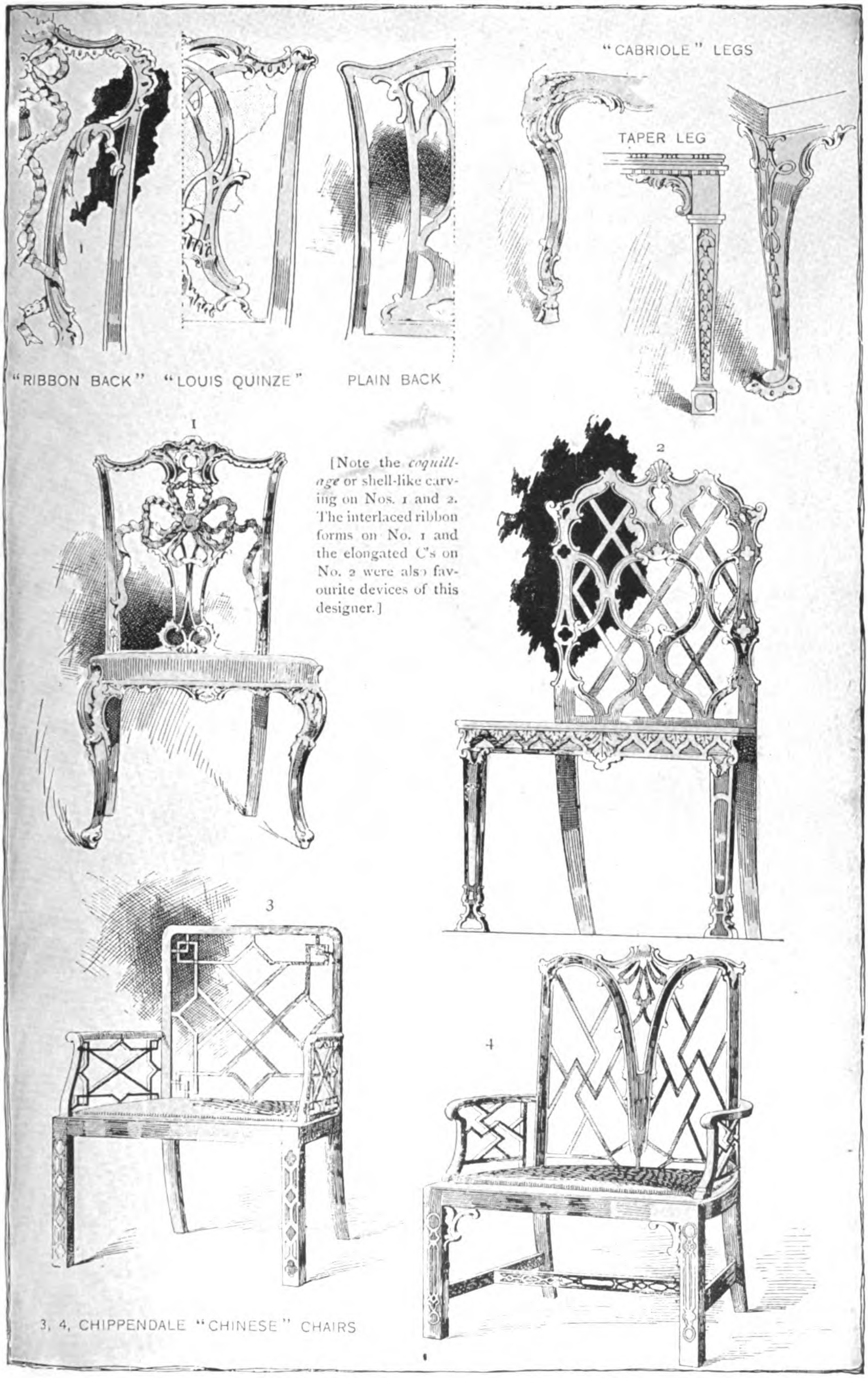
FURNI (foor'nē) **ISLANDS,** a group of the Grecian Archipelago, situated between Samos and Nikaria. Furni is the largest and gives its name to the group. Its area is about 10 square miles and it is the only inhabited island. Its inhabitants are almost cut off from intercourse with the outer world.

FURNISHING GOODS. See CLOTHING AND FURNISHING TRADE.

FURNISS, Harry, English illustrator and caricaturist: b. Ireland 1854. From 1880 to 1894 he served on the staff of *Punch,* producing many humorous cartoons on social and political life. He started two comic journals on his own account, but the venture proved a financial failure. His numerous artistic contributions to the wide series of British and American illustrated journalism brought him international fame. As a humorous lecturer with «lightning sketches» drawn before the audience, he toured the United States and Great Britain with much success. He wrote 'Romps' (1885); 'Royal Academy Antics' (1890); 'P. and O. Sketches' (1898); 'America in a Hurry' (1900); 'Confessions of a Caricaturist' (2 vols. 1901); 'Poverty Bay' (1905); 'How to Draw in Pen and Ink' (1905); 'Our Lady Cinema' (1914); 'Political Sale Catalogue' (1914). He also illustrated complete editions of Thackeray and Dickens, besides other works. In later years he wrote and acted for moving pictures.

FURNITURE, formerly all the various movable appliances or articles in the interior of a house, now more commonly applied to articles of wood or metal. The ancient Egyptians aimed to variety rather than symmetry in the arrangement of their houses. They had chairs made of the finest woods in great variety of design, covered with rich cloths or skins, and inlaid with gold or ivory. They also used folding stools, sofas, couches and carpets or rugs. Their tables were of variety of shapes and constructions. Bedsteads were made of wickerwork and sometimes of bronze. The forms of household articles of furniture found in or represented on Assyrian monuments and remains show great artistic elaboration and a profusion of highly wrought ornament. The Assyrians were especially skilful in the chasing of metals, and they delighted in reproducing natural objects on their ornaments. The Greeks had couches covered with skins or drapery, on which several persons might lie with their bodies half raised; these were used at meal times by the men only, women and children sitting on seats; they had large armchairs with footstools, portable small chairs without arms and stools with carved legs made to fold up.

Among the Romans, Greek art gained a predominant influence, and the conquerors of the world were at all times glad to employ natives of Greece to design and execute the works intended to display the opulence of their masters. On the ornaments of the *triclinia* or couches on which they repose, immense sums were bestowed. They were often inlaid with precious materials, such as ivory, tortoise shell, gold and silver and had ivory or metal feet. They consisted of a framework which was strung with girths, on which rested a mattress stuffed with straw, wool or feathers, and covered with rich drapery. The *lectus cubicularis,* or bed, was higher than the couch, but not unlike it. The tables were generally of costly foreign wood, resting on frames of carved marble or an ivory column. The curule chairs, or seats of state of the patricians and magis-



CHARACTERISTIC CHIPPENDALE CHAIR-DESIGNS

Thomas Chippendale flourished about 1750–1760. His "Design Book" was published in 1752

CHARACTERISTIC HEPPELWHITE FURNITURE

Messrs. A. Heppelwhite & Co., Chippendale's successors, published their "Design Book" in 1789. The Hepplewhites were designers rather than manufacturers

trates, were wrought in ivory; and to form an estimate from the number of beautiful utensils in marble and bronze richly chased and inlaid with silver, that have been found in the ruins of a comparatively insignificant city, Pompeii, the wealth of the Romans in movable property of this nature must have been very great. The library first appears as a separate apartment in a Roman house; that discovered at Herculaneum was small, and lined with presses about the height of a man, in which the rolls of papyrus and parchment were kept. Still, according to modern ideas, the Roman rooms would seem rather bare of furniture. They had no writing tables or cabinets; couches, chairs, tables and candelabra comprised the whole of the furniture with the exception now and then of a water clock, or a chafing dish.

Among European states from 500 A.D. to 1500, the ecclesiastical style prevailed in furniture as in every other species of art, attaining its greatest eminence in the decorated Gothic of the 14th century. Articles of furniture previous to 1500 are very rare. For three centuries after the Conquest domestic furniture was very scanty. The hall was furnished with tables and benches, the furniture of a bedroom consisted of little more than a bed and a chest. Chairs were large and cumbrous, and were usually fixtures; wooden forms, sometimes with back rails, being placed against the walls. The furniture of the dining-room was very limited. Boards on trestles were in general use as tables. In the 14th and 15th centuries remarkable progress was made and a considerable degree of splendor in furniture was attained. Defense began to be not the only object studied in the construction of buildings. The Gothic paneling of the carved bedsteads, chairs, screens, etc., was dazzling with scarlet, blue and gold, and costly embroidered hangings and curtains heavy with heraldic symbolism, cabinets, reading-desks, prie-dieus, ivory and enameled coffers, fire dogs or andirons elaborately chased and gilded, began to appear.

The progress of this decorative style was suddenly arrested by the "Renaissance," or revival of ancient classical art and literature, of which Italy was the earliest seat, and from whence the impulse was given that communicated itself speedily to the rest of Europe. A genuine and self-evolved style instantly went out of fashion, and was discarded for an imitation and counterfeit one based on the copying of understood classic models which were applied without consideration to the most incongruous objects. The classical temple was the dominant idea in the manufacture of furniture as well as in the construction of a palace or a cathedral, and columns were considered as necessary in one species of art as in the other. All the architectural details of Roman buildings were then applied to furniture; the lions, griffins, chimeras, etc., of the temple frieze encumbered the stately pillars of the Italian palaces, and caryatides and Roman trophies replaced the patron saint and the crucifix. With all its absurdities, it must be noted that this style was in the hands of great men, and their productions display a boldness and vigor of line, and a mastery over human and animal forms that give dignity to a licentious freedom of design in which all appropriateness is forgotten. Specimens of the Renaissance are still met with, though daily increasing in value. Gothic art never recovered its lost ground.

With various modifications the Renaissance style continued dominant for nearly two centuries. In England it degenerated into positive ugliness, the furniture of the time of Elizabeth and James I having very little to recommend it in tasteful design. It is distinguished by a mixture of overwrought heavy molding, combined with thin spindly columns, twisted legs, and other inelegant characteristics. Magnificence is sometimes attempted in the value of the material, as in the famous set of chamber furniture in chased silver executed for a royal visit at Knowle Park, the seat of the dukes of Dorset in Kent. It was succeeded by the style named after the French monarch, its patron and encourager, Louis XIV.

The modern predominance of France in the construction of furniture is owing to the minister Colbert. He it was who brought together the best workmen of Europe, and by an edict of the year 1667 established the French royal manufactory of furniture. The new style which the productions of this establishment assumed appears to have been worked out undesignedly, and, like every such successful phase of art, was the genuine product of circumstances. Novelty and magnificence seem to have been the great features aimed at; these were sought by varied treatment of surface in cabinet furniture (as inlays of metals, ivory, enamels, porcelain tablets, tortoise shell, etc.), and by an incrustation of broken scroll panel work, which hid the real constructive forms and frittered away the graceful outlines of the Renaissance into a confused and unsymmetrical mass. Under Louis XV the same school of art continued, and it received new elaboration under the successors of Boule, Riesner and Gouthier; their works are known to connoisseurs as articles of vertu by the respective styles of each master, and fine specimens bring almost fabulous prices. Probably more of this class of furniture is to be found in Great Britain than in all the rest of Europe, a great change of owners having been brought about by the French Revolution. While the splendid extravagances of Louis XIV were holding sway in France, the prevailing taste in England seems rather to have been modified by the fashion introduced from Holland by William III. The native woods, oak or wainscot, chestnut, etc., were about this time superseded for furniture by the dark and heavy West India mahogany, the invariable material of the ill-designed and awkward furniture familiar to us in the immortal designs of Hogarth. A better style based on that of France was introduced by Chippendale, but a severer and more artistic taste was displayed by the designs of Heppelwhite and Sheraton. In the latter part of the reign of Louis XVI another change is apparent in French furniture. Greece and Rome were looked up to as standards of correctness in furniture as well as in politics. But instead of impressing their own genius on designs inspired by ancient models as did the great artists of the Renaissance, the authors of this revival were too often content with frigid imitation. The classical style did not long hold sway, and since that time the practice of both France and England (and with them the rest of Europe) has been purely eclectic. At present designs after the best work of the older makers are much in favor in both Europe and America. See FURNITURE INDUSTRY IN AMERICA, THE.

FURNITURE, Colonial. When the colonists first landed, and during their early struggle for existence, little if any attempt was made to import furniture, and we have nothing now which could be rightfully claimed to have been brought over from Europe before the coming of the *Mayflower* (1620). The New Englanders were the first to make furniture, copying the designs of the original pieces, which were of heavy oak with severe lines and flat carvings. Their puritanical minds apparently abhorred anything of an ecclesiastical cast. As early as 1650 the Southern planters imported fine pieces from England, of oak, richly carved and inlaid, the designs being influenced by the Renaissance just dawning in France, and the Elizabethan and Jacobean periods in England. The authorities in the South tried to prevent trade with Holland and New England, so a comparison of the English furniture, prior to the Revolutionary War, with that of Maryland and Virginia, shows that the English life of that time was planted there as far as it was possible. Since we find so few of these original pieces, we can only think that the planters, becoming wealthy so rapidly, and wishing to keep up to the «prevailing English style,» must have discarded the old for the new, as their invoices show large importations of furniture up to the Revolutionary War.

There was a marked difference between the houses of New York and of New England. The Dutch built theirs of brick, while those in New England were mostly of timber, and a striking feature in the living-room of the former was the chimney-piece, which among the wealthy was elaborately carved and tiled and held vessels of brass repoussé and Delftware. The fire-place with its colored tiles continued to be a decorative feature, even after coal succeeded wood as fuel and grates took the place of andirons. The floor of the average house was sanded, and rooms had no special character. The ideas which the Dutch brought from the Orient influenced the designs not only around New York but in New England as well, and fast grew into favor. Strange shapes from the East, introducing marqueterie in exotic woods, were eclipsing the old chests of drawers, cupboards, etc., and actual products of the Far East filled many of the Dutch houses. The cabriole legs superseded the severer lines. Other woods beside oak, such as walnut, pine, red cedar, maple, etc., were introduced; ebony was scarce, so the «black egg ornament» was often of white wood stained black.

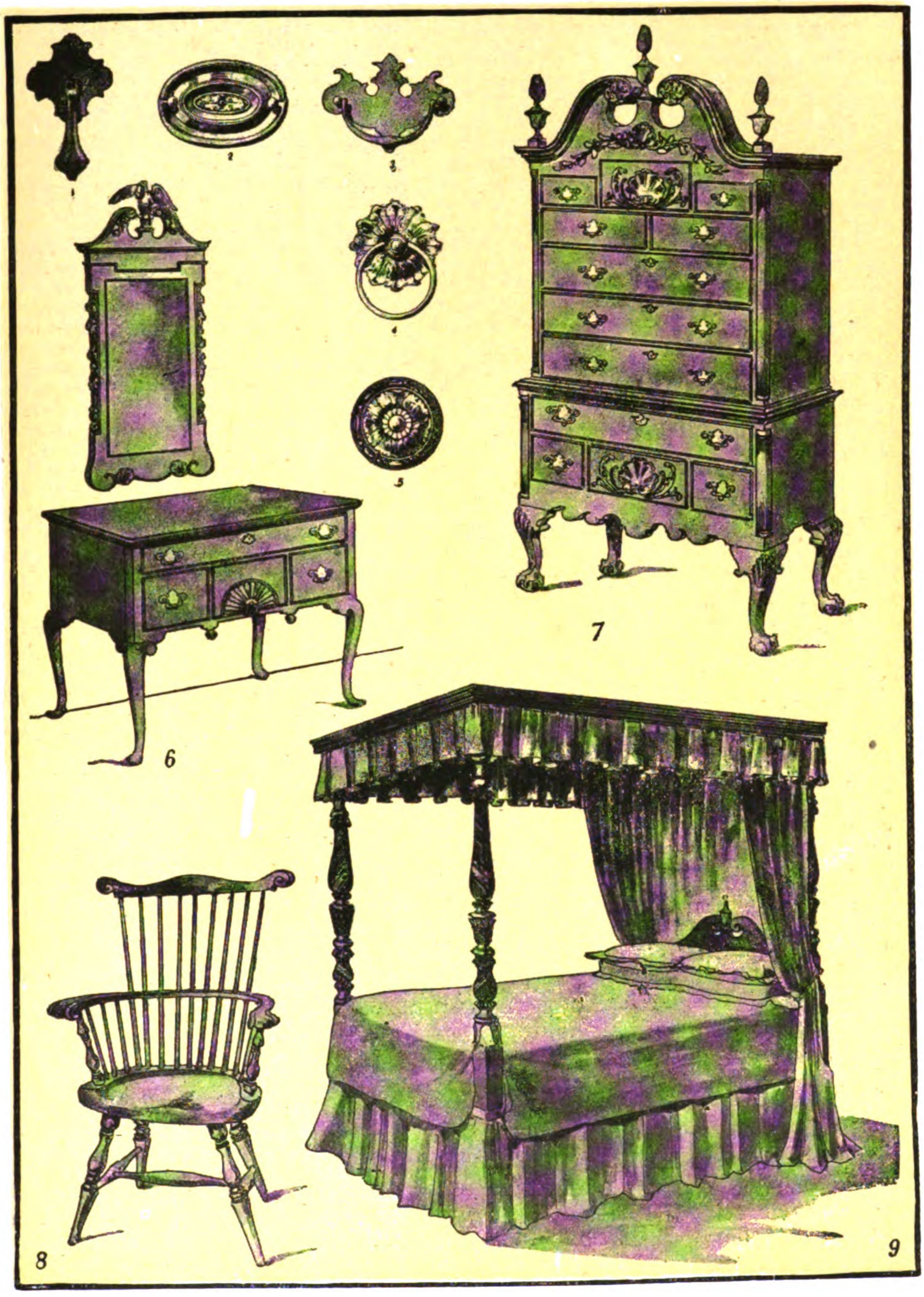
In the first half of the 18th century New York was an important place, and inventories show that fashions in New York compared favorably with those of London and Amsterdam. The bed was disappearing from the hall; carpets were introduced, and in 1750 they had flowered carpets and «painted floor cloths.» The walls, of houses of the better class, were papered before the middle of the 18th century, and for 50 years we have an interesting wall-paper period; their chief designs were large illustrating panels, such as «The Lady of the Lake,» «The Four Seasons,» etc. Fire-places were growing smaller as wood was harder to obtain, and in 1745 Franklin invented what is now known as the «Franklin stove.» Upholstery was taken up and there were many cabinet-makers in New York, Boston and Philadelphia; skilled workmanship was in demand, and «choice timber and metal furnishings for cabinets» were advertised. Then came the period when mahogany was the favorite wood, and, just as in England, all designs had a tendency toward greater lightness and grace of line, and showed the Chinese influence strongly. In 1776 the home of a wealthy American compared favorably with that of an Englishman in similar circumstances. «Chippendale» was the rage, both imported and domestic. There was a marked difference between the North and South — the Northerners lived more simply, but with a certain amount of fashion and elegance; in the South everything was ease and luxury, and many houses were noted for their costly furnishings. Around Charleston, S. C., at the present time are some excellent examples of typical Southern homes of the 18th century, containing many of the original pieces of furniture. The classic or Greek style adopted by Adam in England found its way here, and was seen in architecture and interior woodwork, noticeably in mantels and built-in cupboards, but was little used in articles of furniture.

Mount Vernon — now a museum of relics—is the most interesting colonial house, on account of its associations. It was inherited by George Washington in 1751 from his half-brother, Lawrence Washington. Soon after it was almost entirely refurnished, and though by no means palatial was extremely comfortable. There were few of the original Washington pieces left there, as Mrs. Washington bequeathed the furniture to four grandchildren, but now many articles are gradually finding their way back, either through gift, or through purchase by the Mount Vernon Ladies' Association of the Union. There are many Washington pieces, used by him while in Philadelphia, now in possession of the Historical Society of Pennsylvania. Second in interest is Monticello, the home of Thomas Jefferson. Its architecture and decorations are delightful, and it still contains proofs of the owner's good taste and love of art.

«Colonial designs,» as termed in the vocabulary of the dealer of to-day, were not known until the colonies had become States. They are traced in America first through the Dutch, who had taken many points from Spain and the Orient, namely, the ball and claw pattern. Chippendale adapted them with more lightness and grace of line, but the French Empire style which came in at that time changed it into the massive mahogany, and gave the rope-carved pillars and lion-claw feet. American makers omitted the elaborate brass and ormolu trimmings used by the French, and depended upon the beautiful grain of the wood, often veneering to obtain handsome effects. The superiority of the old furniture is due to its construction; the old makers worked solidly, dove-tailing and blocking all drawers, and to-day the age of the wood has greatly added to its value; the stained mahogany loses the beautiful golden shafts of light. The polish was attained by constant rubbing, while to-day most pieces are simply varnished.

Mahogany was brought into England by Sir

COLONIAL FURNITURE



1-5 Handles
6 Dressing table — Constitution mirror
7 High-boy
8 Windsor chair
9 Four-post bed

Walter Raleigh, but was not in general use until about 1725. In New England it was extensively used a little later, being imported from the West Indies. The Honduras and Mexican varieties most commonly used to-day do not materially improve with age, and are much lighter in weight than the West Indian, therefore a really old piece may often be told by its heaviness. The date of a bureau, chest of drawers, etc., may frequently be ascertained from its handles.

Handles.— The oldest handles, chiefly brass, rarely pewter, were drop-handles, formed like an earring, backed by a small plate. Next in order was a larger plate, usually engraved, with a bail large enough to insert two fingers. The next was a larger plain plate similar to a fleur-de-lis in shape, the bail being much larger, and from now on held into the drawer by brass nuts instead of wires as formerly, but in reproductions iron nuts are nearly always used. It gradually developed into a thin oval plate embossed with moldings, sometimes with centre design, and the bail, fitted into posts, falls outside the plate, preserving the same curve. Still later came the knob and empire rosette handles, sometimes with ring, usually of brass but also of glass or plain wood.

Chests.— No matter how meagre an inventory, it always included a box, chest or case. First the ordinary ship's chest of pine with iron handles, which was appraised very low. There are several good examples of these in State historical societies, including one brought over in the *Mayflower*. Few of these were made after 1725. The oldest carved chests were in low relief with often the date and name of the person for whom it was made; they were afterward made with one drawer, having panel or turned ornaments. This developed into the «chest of drawers,» made of oak and more elaborately decorated, which in turn developed into the «chest upon chest,» sometimes having as many as nine drawers, and the three-tier «steps» for displaying china was sometimes placed upon these. The «high-boy» is not mentioned until the chest of drawers was placed upon a frame about three feet high, having one or more drawers; it had six legs, and later the part where the centre legs were omitted was finished with «drops.» This, in the latter part of the 18th century, became a very handsome article of furniture, with carved top, usually «shell» or «sun» pattern, decorated with gilt torches or balls and cabriole legs and carved feet.

The Dressing-Table, or «low-boy,» came from England in 1716. At first it had but one drawer, afterward it was the same as the frame for the «high-boy,» only about three inches lower. The «high-boy» and «low-boy» were often made to match. The Chippendale and Sheraton designs were usually furnished with dressing-boxes and mirror.

The Settle was an evolution of the chest. Handsome examples are rarely found in this country, although there are many varieties of the «fire-side» settle in painted pine and oak found in New England, with a shelf to hold a candle. The settles which appeared in the latter part of the 18th century, following the Chippendale, Sheraton and Heppelwhite designs, might better be termed sofas, which later took on the Empire designs, with «claw-and-ball» and «wings-and-claw» feet, and «cornucopia» and «swan-neck» ends.

Beds were among the first and most frequently mentioned articles of furniture in wills, being highly prized. In the 17th century the Southern planters owned elaborate European bedsteads, usually of oak. In New England they were very simple affairs, while among the Dutch the bed, at first, was only a sort of bunk. The four-poster soon supplanted all, first of oak, but later of mahogany. Some were most elaborate, with rope-carved, or pineapple and acanthus-leaf posts, and ball-and-claw feet, with tester drapery, valance, curtains and coverlet to match, of white or bright-colored materials, chiefly drugget, linsey-woolsey or dimity, though later chintz was popular. In the South, mosquito canopies were prevalent, sometimes colored to match the color scheme of the room. Feather beds were universally used, resting on ropes or sacking pulled taut, and owing to their height, «bed steps» were necessary. We also find mention of turkey feathers and cat-tails being used as fillings, and early in the 18th century hair mattresses appeared.

Cupboards were usually built into the wall, and whether called «livery,» «court,» «standing» or «press,» were all fitted with light movable shelves to hold linen and display china and glass. There are few of these open cupboards to-day. First the upper part was enclosed with doors (later ones show glass doors with lattice work), afterward a drawer was added, then the lower part was enclosed, and when fitted with lock and key was highly prized as an article of furniture. These partly opened cupboards were called «beaufait,» afterward contracted to «boufet.» Closed-in cupboards show German as well as Dutch origin, and the finest examples were found among the Dutch, usually spoken of as «kasse,» carefully carved and painted.

Chairs are scarcely mentioned before 1650, forms or benches being used almost entirely, the chair being considered the seat of honor, but toward the end of the century there was a marked increase in the numbers mentioned in the inventories. They were made of oak, pine and walnut, turned or paneled, simply carved and with high backs, the seats either rush or cane. About the 17th century we notice leather and «turkey-work» seats with brass nail-heads. The «ball-and-claw» foot, introduced by the Dutch, appeared at the close of the 17th century and remained in favor for nearly a hundred years. Chairs made of wicker and cane were known as early as 1711, and in 1720 came the painted chairs from Holland, usually black, often decorated, with rush or cane seats. The Windsor chair, first made and used in Philadelphia in 1725, was the most popular style up to the 19th century. It was usually of hickory or ash and had a wooden seat, the back was high and either «spindled» or «fan-shaped,» sometimes having an extra headpiece. The style known as Chippendale appeared in 1720, the development being apparent before Chippendale worked. Its chief characteristics were the traceried splat, bow-shaped back and cabriole legs, also the «plate-backed,» which was a solid splat, usually jar-shaped, and hoof feet. The all-upholstered «wing» chair seemed to be in general use before 1750. Mahogany was now easily procurable and the tendency was toward greater lightness, and most of the designs, from now on, follow the English cabinet-makers; Chippendale, with a strong Chinese influence, then Sheraton and Heppelwhite, some being beautifully decorated with hand-paintings, carvings and inlay. In 1770 we have another style, modeled after the old "splat-back," but with the splats crosswise. About 1800 the style commonly known as "empire" began to be felt, and gave us the "lion" and "bear" claw-feet and rolling backs, copied after old Egyptian designs. The strong empire was partially modified here by the Sheraton influence. There is a style in America, a modification of the empire, with heavy mahogany splat-back, usually jar-shaped, often having the back and back legs in one piece. These were in favor until 1840; they were usually covered with "horse-hair" and are now offered as "Colonial" designs.

Tables.— What has been said of the development of chairs may be applied to tables, as almost every form of chair had its corresponding table. First we had the "table-borde," a board, often 12 feet long by 2 wide, resting on a cross-legged trestle. It gradually became customary to leave the "borde" on the trestle instead of removing it after each meal, and it was then known as a table. Marble and slate-topped tables appeared about 1693, and were considered "the latest thing." Before the 18th century we had imported "chair-top" tables, "drop-leaf" and the "100 legged," which was the first extension table, all with turned posts. About 1735 the Dutch influence was strong, and to-day we have some excellent examples, dating from 1750, of mahogany "pie-crust," "dish-top," etc. The "centre-pillar" table came in with the Empire period. Tea tables were found in every parlor of the 18th century, always ready with complete tea-service, spirit-lamp, kettle, tea-box, tongs, strainer, etc. Among the Dutch the table was frequently of rare or japanned woods, many with adjustable tops. Card tables, of which there were many, usually had a plain surface, though some were covered with green cloth; they had folding tops and corner shallows for counters. Work tables were mostly of Sheraton design, the top lifting up, disclosing compartments for sewing materials. Candle tables were of various heights, with a top only large enough to hold a candlestick.

Desks.—A desk was originally a wooden box with slanting lid, the writing materials, and frequently the Bible, were kept inside under lock and key, and the top served the double purpose of reading and writing desk. The large desk or "secretary" appeared about 1660 and seems to have been another development of the "chest of drawers," usually having two or more drawers in the lower half. The lid on the upper part was either let down on chains or rested on two wooden slides. The interior was fitted with many drawers and pigeon-holes, and they had often secret compartments. Later, a cabinet was placed on top and developed into the "cabinet-top" desk, made in one piece and reaching almost to the ceiling. The "table-topped" desk belonged to a later period, a good example being the one used by Washington while in New York in 1789, now in the city hall. There are some good specimens of Sheraton and Heppelwhite desks in this country belonging to their respective periods. The later empire or "Colonial" pieces were large and heavy, mostly "bureau-fronts."

Clocks.— There is slight mention of household clocks prior to 1700, but in the 18th century clock-making was quite an art; the Willard brothers of Massachusetts were the first to become famous. Around New York were found some "Frisian" wall clocks from Holland, run by weights, with elaborate designs of gilded and painted mermaids, cherubs, etc. The English "lantern" clock was on the same order, being of brass with heraldic metal work. This developed into the "bracket" clock, through having a wooden hood placed over it for protection; it was very popular about 1700. The first mention of a tall clock is in the latter part of the 17th century, when long pendulums, also moving figures upon the dial, became fashionable. It was spoken of as "clock and case," and was very plain, of oak or walnut but later of mahogany. Many of them were destroyed during the Revolution, the works being hidden and the cases, in some instances, used for shipping bayonets. Few tall clocks were made after 1815. After the Revolution cheaper time-pieces were in demand, and to meet it, clocks having white enamel dials and wooden works were invented. From then on there were many styles of cheap clocks for walls and mantels, including the "banjo" clock patented by Willard in 1802; the "lyre" clock and many "Colonial" designs in wood, some with painted glass covering the pendulum.

Looking-Glasses.— The first record is in an inventory in Maryland 1639. They were rare at that time even in England, being imported from Venice. The frames were of olive-wood, black or gilt, and when the glass exceeded four feet were made of small pieces joined by moldings. Later the frames were heavily carved and inlaid, but always retained the Italian appearance. We find mention of a parlor in a Maryland house in 1732, "set off with pier glasses." In New England it hung over the mantel-piece and was known as the "chimney-glass," usually ornamented at either side with candle sconces. At the end of the 18th century the shield and oval glasses appeared, showing the influence of the English cabinet-makers, followed by the Empire, with rope-carved pillars, acanthus-leaf and lyre carvings, sometimes having the top partitioned off for paintings. What is known as the "Constitution" mirror did not appear until after 1800; most of them bore the eagle at the top.

Mirrors, during the 17th and 18th centuries, were either of convex or concave glass with elaborate frames, and were frequently used for decoration.

Sideboards came into fashion about 1780, taking the place of cupboards and side tables. They were nearly always of mahogany. First after Sheraton, with inlay, noticeably the "bell-flower" design down the slender legs; later "Colonial" of heavy mahogany with the cupboards extending nearly to the floor, ball-and-claw feet and rounded pillars, similar to the bed-posts.

Washstands.— First called a "bason-frame." Few good examples before the later part of the 18th century, which were influenced by the English cabinet-makers, and later by the Empire.

Warming-Pans were a necessity, especially in New England. The pan was usually of brass with cover, 14 inches in diameter, with a long wooden handle fastened to the pan by an iron socket. Hot coals were placed in it, and when rubbed between the sheets warmed the beds. They were often decorated with open-work carvings and were quite ornamental hanging beside the fire-place.

Screens were used to protect the face from the heat of the fire, were small, made of embroidery or painted wood, with round or square frame, fastened on a post which could be raised or lowered.

Children's Articles.— We find frequent entries of articles of furniture for children. Cradles, the first one brought over in 1620; high-chairs, also «fenders,» to keep the children away from the fires.

There were several miscellaneous articles of furniture mentioned after 1750, including «dumb-waiters,» now called «butler's trays»; «wine-coolers,» «knife-boxes,» «sewing-boxes,» «clothes-trees,» etc.

Collections.— Some of the many permanent collections of Colonial furniture may be found in the Connecticut Historical Society, Hartford, Conn.; the Pilgrim's Society, Plymouth, Mass.; the Essex Institute, Salem, Mass.; Van Courtlandt Mansion, Van Courtlandt Park, N. Y.; American Antiquarian Society, Worcester, Mass.; Historical Society of Pennsylvania, Philadelphia; Washington's Headquarters, Morristown, N. J.; Independence Hall, Philadelphia, Pa.; and Mount Vernon, Va.

Bibliography.— Singleton, 'Furniture of Our Forefathers'; Lockwood, 'Colonial Furniture in America'; Morse, 'Furniture of the Olden Times'; Wallace, 'Colonial Interiors'; Chandler, 'Colonial Interiors'; Corner and Sodeholtz, 'Colonial Interiors and Exteriors'; and *The House Beautiful* (monthly).

Louise Cowperthwaite,
Of George C. Flint Company, New York.

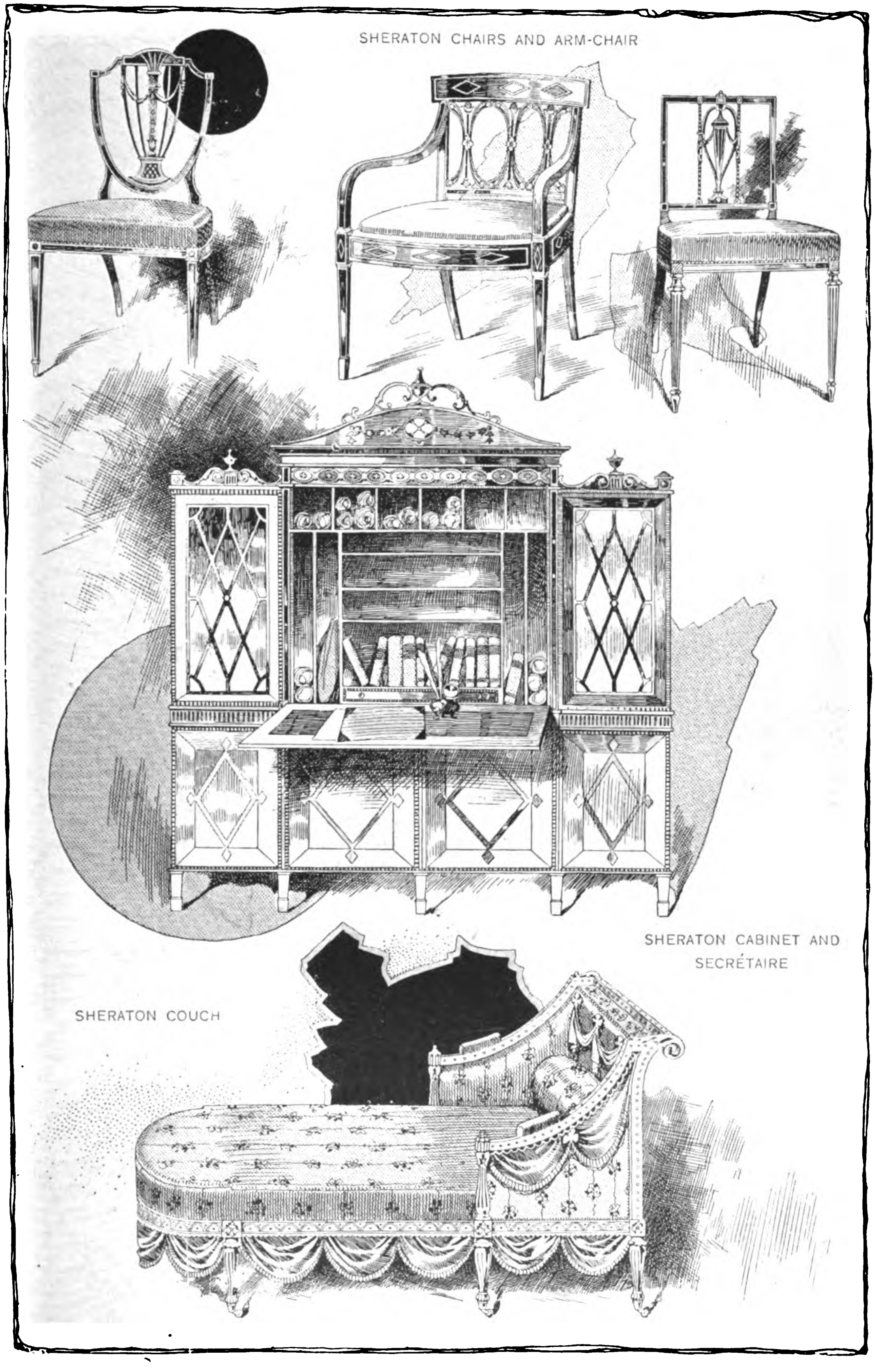
FURNITURE, History of Ancient. In the Far East, in ancient times, little if any furniture of wood or metal appears to have been used in the household, even the palace dwellers contenting themselves with cushions, rugs, curtains and other hangings. Of the furniture used by the ancient Jews little is known, though their long residence in Egypt would lead one to suppose they must have learned the art of woodworking, in which Egyptians were so adept. Even the little knowledge we have of the Babylonian and Assyrian furniture is derived, mostly, from sculptured remains; atmospheric influence long since destroyed such pieces of workmanship. Layard and Smith found that Nineveh furniture was ornamented with heads of lions, bulls, rams, etc. One noticeable feature of Assyrian chairs or thrones was the use of human figures as supports of arms, etc. These are conjectured as representing *captives.* The carved forms of bulls were also used as supports. The tables and couches were of wood and metal encrusted with ivory. Gold, silver and bronze were also used. The luxuriousness of the Assyrian despotic monarchy is fully proved. A Greek author mentions 100 tables and 100 beds, all of gold, piled on the funeral pyre of Sardanapalus. Herodotus tells of altars, tables and statues of gold in the temple of Baal. The thrones had footstools.

Egyptian.— The absence of humidity in Egypt's atmosphere has been the cause of preservation of numerous pieces of ancient native furniture, as well as the vivid depictions of the living habits of its citizens as displayed on the many stone monuments, tombs, sarcophagi, etc. Many furniture specimens extant date back 3,000 years or more. The oldest known piece of furniture in the world is the throne of the Egyptian Queen Hetshepsu, in the British Museum. We find chairs with X legs, like our campstools, with heads of geese carved on the lower extremities of the legs. Some legs and chair-rails appear to have been turned on the lathe; they used mortise and tenon joints and their strength of construction is shown in the fact that 18th dynasty pieces hold firm yet. Seats were of leather, linen cords or plaited rushes. Other pieces extant are footstools with three legs, ebony settees, tables, armchairs, bedsteads, coffers on legs, flower stands, cushions of woven cloth, mattresses, etc. Besides animals, human figures frequently act as supports, as found on Assyrian furniture, and, like the latter, probably represent «captives» or prisoners. Chair-legs show delicate curved forms and clawed feet as in modern furniture, with «tie-pieces» and diagonals to brace the slender framework. Furniture has decorations (besides carving) in gilding, inlays of colored stones, glazes, ivory (both of the elephant and hippopotamus) and different woods. Woods used are acacia, ebony, cedar, sycamore, etc.

Greek.— Concerning the furniture of the ancient Greeks we are far more clearly informed. The early styles are not of complex construction nor are they subjected to much decoration. A common piece was the four-legged stool (*diphros*), first heavily built, then becoming more slender and inlaid with ivory and pieces of metal plate. Some had straight legs, others outwardly bent. The *tripous* was a three-legged stool as its name implies. The folding X legged folding stool (similar to our camp-stool) was in favor from the earliest Greek days and was in two styles, one with curved legs, the other straight, the first being in more common use. In early days these legs actually folded but later, while keeping the same form, they were fixed. The feet were generally carved to represent the claws of lions or tigers, sometimes the hoofs of stags or goats. These claws often turned inwards. Rarely these chair-legs took on architectural forms. The *kathedra* was a chair style used chiefly by women and guests. Its form continued, with slight modifications, throughout antiquity. It consisted of four light legs gracefully curved outwards and had a horizontally curved back-board, about shoulder high, fastened to the seat by strong curved supports. Arms are absent. The most beautiful curved forms appear to have been made about the 5th century of our era. No decoration is found on such pieces. The *thronos* or armchair was a show chair for the reception room. In ordinary civil life it was the seat of the master of the house, in official life it was the seat of dignitaries, in the temples the seat of the gods. In pictures, therefore, of ordinary day life we rarely meet the *thronos.* It was furnished with a back and two arms. The throne seat of honor at public functions differed from that of the ordinary household in being so high as to need a footstool to climb into it. In the later styles we find the back straight and so high as to reach above the head of the sitter. The elbow-pieces of the throne seat often terminated in a segment of a sphere, later to become an animal's head, usually of a ram. Another early type had massive posts as legs, the heaviness being broken by two palmettes joined together by a stem, the legs being cut into the small size of the stem; such archaic style throne seats have the back rests very low and terminating in a human or animal figure, this decoration appearing at times on each corner of the seat. Another form of leg decoration has volutes where the joints of the front and back legs meet the seat. Still another throne leg style is the turned "baluster." Lastly, there was the massive stone-built *thronos* used by dignitaries in theatres, for judges, princes, and acting as seats of the gods in temples; some are quite plainly built, others have all kinds of pictorial representation as the Sphinx, griffins and other animals. The Greek bedstead (*kliny*) closely resembles the Roman *lectus* in the main and answered for two kinds of furniture of the modern house — the bed and the sofa. But the antique sofa was not made, like the modern, for seating several persons, but was for one person to recline on; in this the dining couches were an exception as they were so large that several persons reclined alongside of each other. Originally the *kliny* was intended as a sleeping couch and only when the old custom of Homer's day of sitting at meal times went into disuse and one reclined at meals did the *kliny* find any use except for sleeping. Reclining then became the custom also for writing, studying, etc., and the more diverse the uses for this piece of furniture became the more they advanced in art handwork, in alteration of construction, according to the use they were to be put to, this without changing the fundamental form at all. This main form answers, in general, to the modern *chaise longue*, having only a raised projection at the head end. They have occasionally head, foot and back pieces, like the modern sofa. The difference, which maintains the bedstead character of the piece, is the absence of fixed upholstering and use of bolsters and cushions. The bedstead (*kliny*) is made of wood or bronze and consists of an oblong framework mortised to four corner posts and resting on four feet. Over this is stretched webwork or straps (*tonoi*). This is all that is found in the more primitive pieces. There is usually, however, a raised head-piece and, less frequently, one at the foot that is not as high as that at the head. The Greek bedstead was often so high as to need a stool to reach it. Ancient Greek tables were of two kinds: the tables off which they ate and those used as a dresser. In Homer's time people ate their meals seated at table; later they ate in a reclining posture. We read of each person, at times, having the meal at his separate table; these must have been small tables with round or square tops. And this fact is further proved by statements that these tables were used as shields in cases of murder. Again we read of a number of persons eating in common at one table. This larger dining table was displaced by small tables for the drinks when the *symposium* followed the meal. These tables were oblong and were furnished with three legs, one only at the foot end of the reclining guest at whose couch (*kliny*) it stood beside. A shelf was sometimes placed below the table-top upon which to rest the utensils after use. The use of only three legs would make the table more steady considering the unevenness of the unboarded floor. The dresser or display table (*abax*) was divided into separate compartments in which wine cups were placed; it was a species of cupboard or early credence on which to array gold and silver vessels.

Roman.—As might be supposed, the Roman and Greek furniture are very closely similar, and the earlier Greek civilization afforded the models. The common stool (*sedile*) was like the Greek *dithros;* the bench was termed *scamnum* or *subsellium;* their settle was called *sella,* while the magistrate's stool was known as *sella curulis.* A special wide seat, without back or side rests, was the *bisellium.* The Roman *cathedra* was a magistrate's chair but also designated the comfortable, cushioned armchair of the women. The *thronus* or *solium* was the elevated chair dedicated to the gods, kings and other illustrious personages. The Roman bedsteads (*lecti*) formed several functions, like those of the Greeks, and were called, according to the purposes for which they were intended: *Lectus cubicularis* was for sleeping purposes and was generally open on all sides (*spondus*), some had a backboard (*pluteus*); *lectus lucubratorius,* for study, often had an attachment on which to write; *lectus tricliniaris* was used to recline on at meal-times. The Romans favored a rather large round table, for convivial purposes, with one leg (*monopodium*), a style not found among the Greeks. They were very costly, and had legs of ivory, silver, etc., and the much-prized African *thya* wood in beautiful grains formed the tops. On such tables were used marble, gold, silver, bronze, engraved and damascened work; they were even enriched with precious stones. Inconceivable prices were paid for such pieces of furniture and we are told that Cicero's table cost a million sestertiæ (over $45,000) and that of King Juba fetched over $50,000 at auction. Such tables were not used with the three rectangular couches (*tricliniaria*) but with a semi-circular sofa (*sigma*). When the Romans gradually became conquerors of the entire known world their excessive luxuriousness demanded elaborate carving as well as inlays of box-wood, ebony, cherry, holly, terebinth, ivory, tortoise-shell, stained horn, etc. Beautiful veneering was done to bring out artistic designs of the fanciful grains. In furniture construction they used cedar, pine, elm, olive, ash, beech, bird's-eye maple, ilex, etc. Bronze tripods of most exquisite designs were a much favored form of stand with the Romans as we know from the numerous examples excavated from ruins.

Byzantine.— The art product of Byzantium or Constantinople was the outcome of the centuries of war, which ended in the dissolution of the Roman Empire besides destroying all vestiges above ground of the costly furniture of the period. True Byzantine art lasted till about 1202, when the city was taken by the



CHARACTERISTIC SHERATON FURNITURE

Thomas Sheraton (1751-1806) was the last of the famous cabinet-makers of the 18th century. In 1790 he published his first collection of " Designs for Furniture," and this was followed by numerous other publications of a similar class

Permission of the Metropolitan Museum of Art, New York

English Corner Cabinet 1725-30; black lacquer with Chinese scenes in gilt

Latins. It differed from the Classic art in absorbing Oriental motifs and combining them with Greek in a manner that has ever since had world admiration. With centuries of luxury and prolific art production nothing remains of her furniture except several chairs or «thrones,» supposed to be of Byzantine origin. The Iconoclasts did more to destroy the city's art work than all the devastation of the passing centuries. The so-called «chair of Saint Peter» in the basilica of that saint in Rome belongs probably to a date between the 4th and 6th centuries. Its arcaded back and other details show mixed styles of Classic Greek, Asiatic Greek and Persian. Another supposed Byzantine chair is in San Marco, Venice. In the later days of Byzantium furniture became luxurious and was ornamented with gold, silver and precious stones. There is a seat in the British Museum with a high back which may be of Byzantine make. The so-called Saint Maximinian's chair, at Ravenna, of this period, is of wood overlaid with plaques of ivory carved with scenes from the life of Joseph, but some of the workmanship, at least, is certainly of later date. From manuscripts we learn that beds of this period were of old Roman form. The former custom of reclining at meals ceased and guests sat at table.

Romanesque.— This style is sometimes termed «Romano-Byzantine» and «Italo-Byzantine.» It has been called the debased Classic during the settlement of the Northern barbarians. It grew up in western Europe when Italy and Oriental Europe were flourishing in the Byzantine style. Its furniture is really Byzantine but shows less ornamentation.

Bibliography.— Baumeister, A., 'Denkmäler des klassischen Altertums' (Leipzig 1888); id., 'Altgriechischen Möbelstil' (in *Kunst und Gewerbe,* Nuremberg 1885); Champeaux, A. de, 'Le Meuble' (Paris 1885); Foley, E., 'The Book of Decorative Furniture' (London and New York 1911); Litchfield, F., 'Illustrated History of Furniture' (London 1907); Pollen, J. H., 'Ancient and Modern Furniture and Woodwork' (London 1908); Viollet-le-Duc, E. E., 'Dictionnaire du Mobilier français, de l'Époque carlovingienne à la Renaissance' (Paris 1871–75).

Clement W. Coumbe.

FURNITURE, Mediæval. Much of the few pieces of furniture used by the nations not reached by Byzantine or Romanesque influences was without decoration and consisted of bare boards fastened together. But under Gothic influence the pieces of utility began, in the northern countries, to receive some artistic attention. The wealthy alone owned anything outside of chests and settles. The *bahut* (chest) of the nobility was used as a piece of furniture when not traveling. It acted as a seat, a bed, and often as a table, and when change of place was at hand the bedding, hangings of leather or arras were packed into the bahut. The chest was also known as a *huche,* and the chestmakers or carpenters were called *huchiers.* Continuous warfare subjected Europeans to very frequent and hurried change of abode and the court and nobles had little use for the comforts afforded by much furniture. In early mediæval times the Church alone, with its altars, choir-stalls and patriarchal chairs, possessed permanent, substantial furniture. In the absence of actual specimens we have to fall back on illuminations in old MSS. and the inventories attached to old wills, for information as to the household equipment. By the 11th century we find *dressoirs,* cup *bordes* (on trestles); and the *armoire* takes an early place with the *faldestool.* The bedstead was built into the wall. Even the luxuriousness of the French was one more of show than of comfort right into the 15th century. And, while we read of beautifully carved wainscoting and ceilings, these rooms held but few chairs, mostly hassocks (*carreaux*) or cushions, carved bench, perhaps, while the magnificent bahuts, architecturally constructed and decorated, hold immense services of the precious metals to be displayed on state occasions (their silver and gold services representing their only realizable wealth). When a medium of exchange was needed this precious metal was melted down for payment.

European Furniture.

Italian Furniture.— The Gothic style never gained a full hold in Italy, for, as Dr. Semper says: «Already by the 12th century the Renaissance era was opened in furniture, especially in Italy.» Most of these Gothic pieces are found in the church furnishings, as closets, with Gothic façades, and were used in chapels, choirs, sacristies, etc. For a short period in the 14th century Gothic architectural motifs were used in structural parts as niches, pillars, balustrades, etc. When (1453) Mohammedans captured Constantinople, the Greek artists, fleeing to the west, brought back the grand Classic traditions and the Renaissance blossomed forth. A favored method of decoration was painting and the craftsmen's guild of Saint Luke, in Florence (1349), admitted artists as members. Woodcarving advanced in artistic merit, but the greater fondness in the 15th century was still for painted panels for the great wall cupboards (*credences*) and coffers (*cassoni*), and even chairs and bedsteads. The tendency was toward depictions of Biblical subjects, history or fable. The Florentine artist, Dello, did much fine painting on woodwork. Along with this fondness for painted furniture there was an increasing fondness for the marquetry work (called *intarsia*), which, starting with geometric inlays, of black and white woods, had advanced, by the 15th century, to historical and landscape representations in stained woods with very realistic effects. Giovanni da Verona is said to have invented the staining of half-tones with oils and acids. Giulio Majano and Benedetto da Majano, Guido Servellino, Domenico di Marietto, Baccio Cellini, Girolamo della Cecca were noted in that period. In the 16th century great Italian marquetry artists were the family of Bartolommeo de Pola, and the ecclesiastics Giovanni, Raffaello and Damiano. Venice became the most active centre and her marquetry work was in demand all over Europe. The trecento, quattrocento and cinquecento styles of decoration were each well represented in their periods by the furniture makers of Italy. The *credence* or dresser developed into a true sideboard, losing its open shelves. The cabinet grew out of the press or closet. Tables were soon most ornately carved. Bureaus of drawers came into being in the Renaissance. The heavy

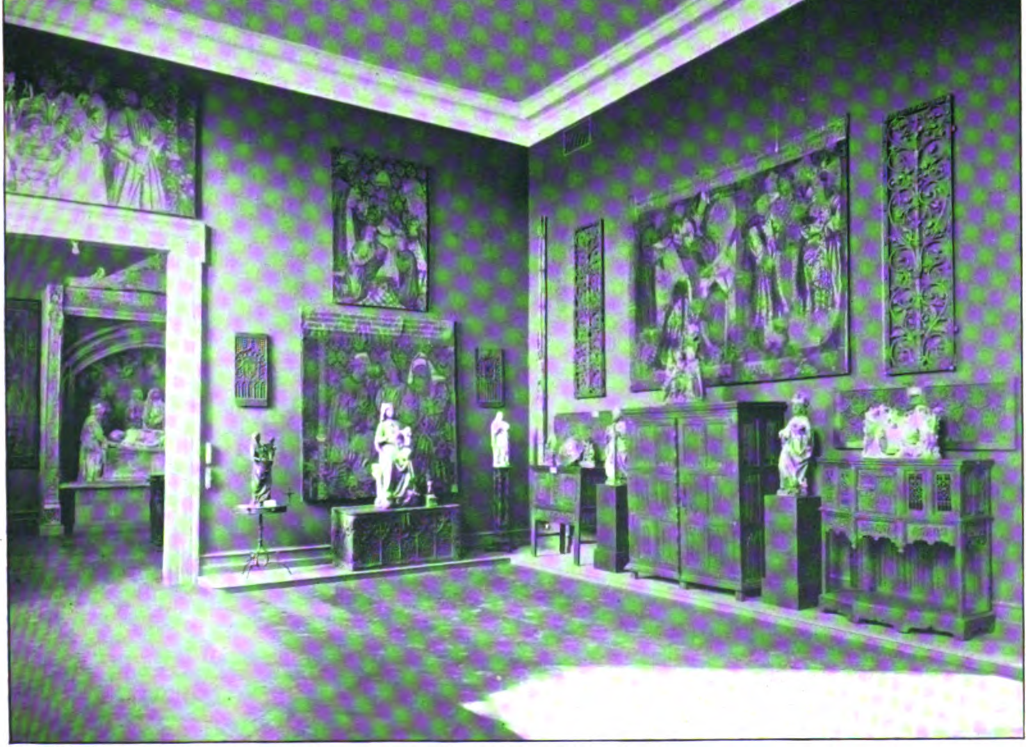
Gothic bedstead became a light frame with slender posts (columns) supporting a canopy of tapestry or brocade, and the high headboard showed magnificently carved designs such as the owner's heraldic bearings. Lovely screens were in use in stamped leather or with painted decoration. The *cassone* (marriage chest) became more and more ornate, receiving beautiful decoration in *gesso* relief, gilding, intarsia and wood carving. An artist noted for such work was Andrea di Cosimo. The 17th century saw the development of bookcases and writing desks as part of the furniture of the wealthy. These were formerly only seen in the great libraries or used by Church dignitaries. The true couch belongs to this period — a piece of furniture for day comfort entirely apart from the bed.

French Furniture.— The Gothic style ruled supreme in the designs of French furniture up to the 16th century; that is to say Gothic architectural motifs and outlines formed the constructive parts. In the 16th century Italian influence sets in and we find Venetian marquetry arabesques adorning the furniture. Francis I, through his campaign in Italy, brought the Renaissance style to France and we find great carved work in caryatids, grotesques and sculptured human heads protruding from medallions in miniature garrets, heavy garlands of fruits. Mythological and allegorical subjects appear on the marquetry panels. Architectural pediments crown the furniture, the «broken» pediment often having its statue in the open space. Under Louis XIII all decoration as well as the furniture itself is characteristically heavy, including the columns, cartouches, garlands, balustrades, furniture feet. The motifs are Renaissance but the lightsome and open work is gone, all is opaque and sombre. Panels are sometimes octagonal. The cabinetwork begins to show the influence of the Flemish *ébénist* (cabinet-maker), for the king had sent artisans to the Netherlands and they had brought back the Flemish Renaissance technique. The queen was Spanish and she introduced Moorish traditions (mosaic incrustations of mother-of-pearl, ivory, etc.). The *chaise à vertugadin* was armless to allow ladies to sit with their immense spreading farthingales. Chairs had often straight medallion-backs; armchairs were of wood entirely; settles, generally bare, had leather or cane seats. The Louis XIII cabinet is typically heavy; it succeeded the dresser and had channeled pilasters to break the front surface; statues in niches were in the upper tier, the swinging doors were paneled. The queen's Spanish goldsmiths made some furniture pieces of solid silver.

Louis XIV Style.— The pompousness of the «Grand Monarch» is reflected in the furniture as a prevailing feature till toward the end of his long reign, when the Bérain style of minuteness and delicacy arrived. With Colbert as Controller-General, ruling the decorative arts with his genius and enthusiasm, with the Louvre and Gobelins factories, aided by the Aubusson and Beauvaix furniture tapestries, France produced furniture that astonished the world and was able to discard Italian and Flemish styles for new conceptions. To this reign belong the art products of the genius of such artists as the sculptors Caffieri, Tuby, Anguier; the engravers Le Clerc, Audran, Rousellet; the cabinet-workers Boulle, Cucci, Oppenord, Poitou, Varin; and designers LePautre and Bérain. The heavy first phase in the Louis Quatorze period is heroic or Roman decorative treatment (trophies of Roman arms, allegorical and mythological figures, cornucopias, cartouches with bulging fields). In the late phase of the period the minute detail decoration of «chinoiseries» by Bérain commence, to continue into the Regence period. Pieces of furniture are broad, heavy, stiff armchairs with capacious backs and massive arms and legs; the couch (*lit de duchesse*) was introduced, also the screen and fire screen of lacquer. Some pieces of furniture are of solid silver. Rosewood veneer appears late in this reign. Bedsteads have plumes (*panaches*) at the four corners of the canopies. Stiff, heavy, capacious, but grand, is the type of furniture of «le Roi Soleil.»

Regency Style.— The King Louis XV was five years old on the death of Louis XIV, and Louis Philippe of Orleans was made regent. The light, graceful arabesques of Bérain, the drawings of Oppenord, the «singeries» (ape-groups) of Gillot were inherited in fresh form from the later years of the former reign. Charles Cressent gave life and exquisite beauty to furniture pieces with his talented sculpture work ornament, in bronze, brass and or-moulu, his delicate tortoise-shell marquetry, inlays of colored woods, etc. Financiers, merchants and the wealthy bourgeoisie were taking prominence in luxurious surroundings. Meissonnier and Thomas Germain brought their genius into this period. In decorative motifs we find the shell (*coquille*), used often in the Louis Quatorze period, is pierced and more or less conventionalized. Multiplied opposing curves and volutes frame panels and mirrors. It is the beginning of the «rococo» decoration. Chiseled copper and bronze gilt are profusely used in ornamentation of wardrobes, bureaus, chiffoniers and sidetables. Corners of furniture display high relief busts of women. Legs bend to «cabriole» curves; tie-pieces are discarded leaving the legs free. Vernis-Martin (see LACQUERS AND LACQUERWORK) furniture is in vogue. Chairbacks are of rounded outline and concave; chests of drawers acquire styles «à la Régence,» «à la Harant,» «à la Dauphine.»

Louis XV Style.— The fashions in furnishing changed considerably in this reign on account of arranging the dwellings (formerly immense rooms) into small apartments of cozy dimensions. With the arrival of these small comfortable suites of rooms, the furniture becomes of reduced size and takes on bolder curves and «bombé» fronts. The «rococo» style with its opposed C's and fantastic shellwork was in full vogue till 1750, when Madame Pompadour converted the court to favor a return to Classic models (first termed *á la reine*). Cressen's genius was now rivaled by Oëben and, later, by Riesener. Other great cabinet-makers were Duplessis, Hervieux, Bernard, Boudin, Olivier, Joubert, etc. Jacques and Philippe Caffieri (sons of the noted Caffieri of the last reign) did lovely furniture decoration. Gladbach came from Cologne and Gouthière did master work in metal adornment on Riesener and other creations. Boucher painted entrancing cupids. The «Duchesse»



1 Louis XIV Room, Metropolitan Museum, New York

2 Gothic Room, Metropolitan Museum, New York

long chair often was divided by partitions; *écoinçons* (corner pieces) or *encoignures* admirably adapted themselves to these small rooms. Hand-made Aubusson and Beauvais tapestries were coverings for *chefs-d'œuvres,* besides satin, velvet-plush, embossed taffeta, chenille, silk brocatelle, etc., in soft-toned colors. Some chair seats were caned, some gilded. Marquetry grew into still greater favor. Trophy motifs are now tied with ribbons and contain bouquets of flowers, groups of musical instruments, quivers (*carquois*), torches, doves, cupids and other Love emblems. To the comfortable «bergères» are added «marquises,» «vis-à-vis» and sofas. Fire screens and folding screens continue greatly in favor. Imitation Chinese lacquers are the rage (*vernis Martin*), with decorations of pagodas, pastoral scenes, groups of gallants, etc. Lacquer artists of note are Watin, Lequay, Girardin. The harpsichord (*claveçin*) became a favored piece of furniture. Bedsteads remained as in the Regency, those *à la duchesse* having no posts. Large chiffoniers had sliding-doors. Writing tables often had flat tops, fluted legs, chased bronze decorations. Cylinder bureaus were in use. «Coquilliers,» or shell cabinets came into vogue, for conchology was a popular fad. These and other cabinets, toilet tables, gueridons, etc., have as decoration cartouches and escutcheons *set always oblique* (it is *rococo*). Armchairs had their arms set halfway back on the seat to allow room for the ladies' hoops of the crinolines in fashion.

Louis XVI.— With the advance in the excavation of the beautiful furnishings of Pompeii and Herculaneum, the Classical style came into full power in the decorative arts. Furniture was built on more rigid lines, but light and portable, even slender, not on the Louis Quatorze massive scale; the former contorted panels now become rectangles with plain lines. A list of tables must include work tables, toilette tables, gueridons (small round tables), «kidney-shaped» tables, consoles, as well as bureaus, secretaires, etc. The tops of tables, secretaires, etc., often have a small «gallery» or balustrade of open-work copper serving as border. Chairs are light, sofas narrow. Bedsteads have canopies and flowing silk curtains; the woodwork is painted or has tapestry panels. It stands in a niche in the wall. Chests of drawers are in mahogany and have eagle-claw feet. Very fancy furniture supports run to griffins and sphinx forms. Most furniture legs are straight and show fluted decoration. Some legs curve *inwards.* Carving is always carefully executed. Seats, sofas, benches and forms have stuffed cushions; much of these are more the work of upholsterers than joiners or cabinet-makers. The armchair «à medaillon» (medallion back) is a characteristic Louis Quinze piece. The «tête-à-tête» settee held only two persons. There were «tabourets à accotoirs» (stools with sides to lean on); the «cabriolet» was a small seat for the boudoir; the «pliant» (folding chair) had X supports. Decorative motifs are the Classic: egg-pattern (*oves*), molding, laurels, chaplets, strapwork, palms, antique urns, heads of lions, pine-apples, rings, crowns, imbrications, medallions, shields, quivers. Truly characteristic is the «flowing ribbon,» found also knotted. Noted cabinet-makers were Roentgen, Beneman, Saunier, Schwerdfeger, Avril, Carlin, Lavasseur. Riesener continued his successes. Noted carvers were Gouthière, Clodion, etc. Thomire was a talented bronze worker.

Empire.— War had done its work. Art talent and inspiration were dead. Cæsarism produced mediocre copies of the Roman models in the coldest form. We find *curule* chairs, referring to the Consulate; candelabra (*lampadaires*); there are «Neptune» beds, «trophy» beds. Tables are mostly round, and consoles, pier-tables, etc., have frequently marble tops. There are bookcases, cabinets, secretaires, dressing tables, all in the sombre, heavy, exaggerated «Roman» lines. Desks often have a hinged flap that lets down. There is an excess of veneering. Mahogany is in its fullest vogue, but does not lend itself well to the chisel; it best displays itself in architectural molding and turned work. Its mottled and veined beauties show best in flat, polished surfaces. The decorative motifs are the sphinx, war trophies in Roman style (helmets, glaives, etc.); the consular *fasces* with projecting axe refer to the consulate of Napoleon; swan-necks are frequent as supports; rams' and lions' heads are common, also the anthemion. The initial N surrounded by a laurel wreath is ubiquitous. The imperial eagle perches everywhere; Liberty (Phrygian) caps and «winged Victories» abound. The Jacob brothers were leading cabinet-makers; Thomire did fine bronze decoration. Architect Perrier devoted time to decorative furniture designs, Fontaine also.

German Furniture.— Germany was in utter pagan barbarism until the English monk Winfrid (about 718) with his missionaries preached the Gospel there. He was murdered there in 755 and canonized (as Saint Boniface) later. In the course of his activities he built Catholic churches and monasteries at Saint Galle, Fulda, Reichenau, Saint Emeran, etc., and in these establishments his followers trained native artisans in woodwork and metalwork. They formed schools and centres for all the arts. They became, by this means, participators in the Carlovingian epoch. But till the 13th century the arts were almost entirely devoted to the Church. Secular furniture remained mostly roughly carpentered pieces, such as trestles and boards for tables, benches of wood for table seats, benches of stone or brick built into the walls for the retainers. The earliest pieces in the decorative arts show Byzantine tendency, then Byzantine-Gothic. With the 13th century the Gothic style of architecture arrived and, of course, the decorative work on furniture was on strictly architectural lines. Gradual advancement in civilization and wealth brought to the middle classes the pieces of home furniture conducive to comfort in civil life. Augsburg, Nuremberg, Ulm, Ratisbon, Lunéville became industrial centres with artistically furnished homes. Artist decorators produced fine carving and elaborate furniture construction, and engravers and artists aided with clever designs for the artisans. These latter so-called «Little Masters» had among them such talented genius as is found in the work of J. Collaert, Theodor and Johann de Bry, of Frankfort, Virgil Solis of Nuremberg Dieterlin, etc. And as productions of these talents we get the most interesting art effects in woodcarving. The German cabinet-makers made beautiful pieces of furniture rich in architectonic design enriched with grotesques, grimacing human faces, etc., boldly yet minutely carved. The German bureau (*Kunstschrank*) with its architectural façade, its multitude of incrustations, and its cleverly hidden secret drawers, was so popularly useful as to have a great demand for over a hundred years. But German woodcarvings are the great inspiration the world over, rivaling the Italian though differing so entirely with the Teutonic love for the feudal and Gothic treatment. Noted workers of the 16th century were Krug, Flötner, Teschler, etc. Peter Vischer, Kornemann and others brought the Italian Renaissance to Germany, and the great advances and prolific work of the second half of the 16th century were continued into the next century. Marquetry and encrusted panels, also «pietra dura» or Florentine mosaic (inlays of colored pebbles), ivory and mother-of-pearl inlays were beautifully carried out on bureaus as in Italy. Nuremberg and Augsburg were the centres for such cabinet furniture. Ulrich Baumgarten, maker of the renowned «pommerscher Kunstschrank» (now in the Berlin Museum), was of Augsburg. This art object was built for Phillip II of Pommerania and took 25 years to decorate. Phillip Hainhofer was his partner. Lorenz Zick of Nuremberg did wonderful openwork in ivory. Locksmithing was a German art carried to great perfection in that century with its picturesque metal artistry in chiseled and beaten iron in great and elaborate designs. War in Germany in the 18th century destroyed all chance of notable advancement in the decorative arts; and in the latter part of that century the Louis Quinze style was saturating all artistic endeavor throughout Europe. In the 19th century the great evolutions in furniture brought about by the English cabinet-makers carried everything in the way of opposition before it.

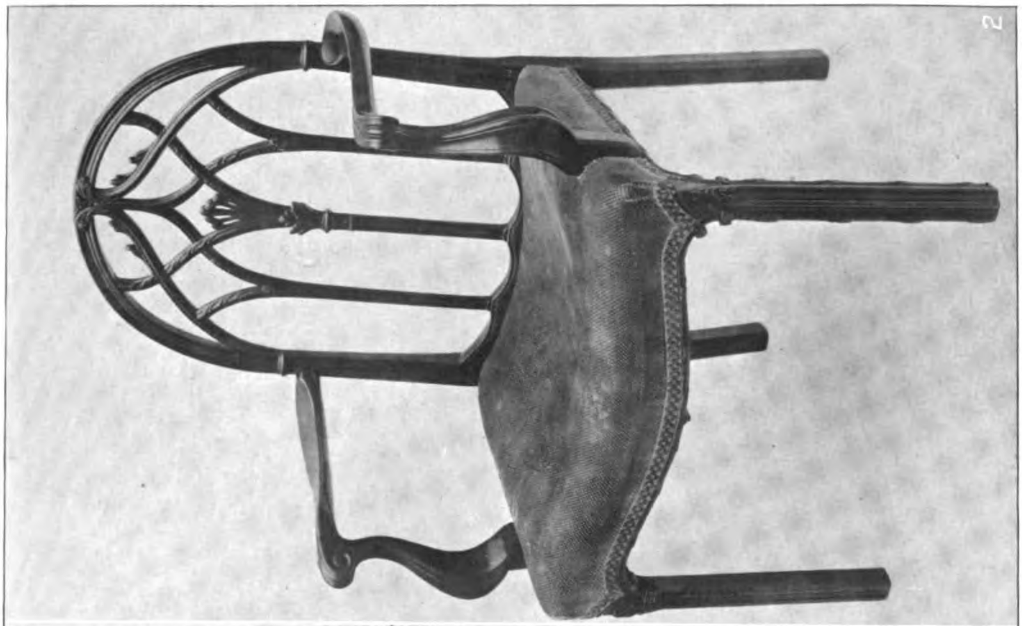
English Furniture.— From its insular position England's progress in the furniture and cabinet-making art has been, at different periods, a tardy copying of Continental styles when traveling experts visited her shores, of developing entirely original conceptions of construction or decoration, or of blending foreign and native methods and motifs. Its earliest, crude work is as its neighbors.

Tudor Period (1485–1558).— Pollen says: «The Tudor style denotes that particular modification of Renaissance mingling with Gothic art, which arose in England under the first four sovereigns of the House of Tudor» (Henry VII, Henry VIII, Edward VI and Mary), «but more especially under Henry VIII.» The development of this style under Elizabeth is called Elizabethan. Henry VIII greatly encouraged the arts and, as patron, invited foreign talent to his court. Artists and artisans alike found profitable patronage. It has been termed the «English Renaissance,» Carving done by native hands is crude flat work, but inlay work shows advance. The «linen fold» pattern carving for panels was in use by the end of the 15th century. Gothic ornamental decoration prevailed till Henry VIII severed relations with the Catholic Church, when Renaissance treatment commenced. Tudor tables were narrow (evolved from the narrow trestle board); they had heavy stretchers several inches from the ground to keep the feet off the cold, damp, rush-strewn stone floor. The credence table or dresser held the foods served at table, and some had enclosed closets below to hold broken food, and shelves above to display plate. Chairs (a rare piece of furniture till Henry VIII) during the first half of the 16th century were similar to the French; the *currule* X-legged chair came into favor about 1530 with curved decoration in front, and the curve at the back had projections above and leather bands stretching across the back to lean against. The «thrown» (turned) spindle chair was for bedrooms and stayed till the end of the 17th century. «Joined» or «joint» stools were in later days called «coffin» stools, being supposed to have been used to support coffins in churches, but were really for private residences. Those extant are mostly Jacobean. Benches and forms were the retainers' seats. Tudor settles were boxed in below and used for storage purposes as well as seats; panels were often carved. The high backs were to keep off draughts, and they were placed at right angles to the fireplace. Monks' bench-settles had backs that could be let down to form a table resting on the arms. In the 15th and 16th centuries the coffer (called often *huche and bahut*) was the principal piece of furniture, serving as bed at night and seat by day; it held the textiles used for comfort and adornment. The highly decorated Gothic ones, seen in museums, are mostly *muniment* chests and held church furnishings. Tudor beds had «testers» supported on four posts.

Elizabethan Period (1558–1603).— The anomaly of Elizabethan furniture is that the earlier pieces are far superior to the later. The Italian, French and Flemish artisans brought over by Henry VIII continued their fine work at almost princely pay. The native makers, already lacking in skill and genius, under the competition, had to produce the cheaper pieces for common use only and, consequently, depended on the quick action of the lathe and rapidly but poorly executed carving. Chairs in this period are more in number but not in common use. They are heavy ceremonial furniture with large seats (hoop petticoats are still worn), and have high, carved, paneled backs, heavy stretchers. Alongside these we see the native spindle (turned), rush-bottomed uncouth pieces. A parlor was added to the living rooms necessitating more decorative furniture. The «withdrawing» table with its «melon-bulb» supports originated with the Italian Renaissance artisans; its legs had carved acanthus and grape-bunch decoration. Its name was derived from the two slabs that could be *withdrawn* on runners so that the table could be extended by dropping a centre slab in the opened space. The «court cupboard» came into use. «Day-beds» were in use, for Shakespeare mentions them; those extant, however, are Carolean or Jacobean. Headposts are not used because the «tester» is supported by the high head-paneling. We find «nail-head» ornament often on furniture. «Elizabethan strap-work» is a species of *intreccio* or interlacing flat band-work.

Jacobean Period (1603–1689).— This includes

1 American Serpentine-front Desk; Mahogany, 1765-1800



2 English Arm Chair. Chippendale style

Permission of Metropolitan Museum of Art, New York

Permission of the Metropolitan Museum of Art, New York

1 English Table; Spruce, gilt lacquered **2 Mahogany Table. Irish Chippendale style 1730-50**

the reigns of James I, Charles I, the Commonwealth or Cromwellian period, Charles II or the Restoration and James II. It has also been termed the Stuart Period. The reigns of the two Charles have been termed the Carolean Period. Woodcarving, descendant of Elizabethan days, is now in its lowest stages. It consists of "scratch carving" largely; this is done by the primitive method of drawing an outline of the design, then excising these lines. Another style is done by chiseling and gouging out a little of the surface and leaving the motif or design in the original flat surface. "Split balustre" was a favored decoration, also pendants on corners of cornices. In panel work the Jacobean Period holds a high position; typical is the "rising" panel built up with moldings so as to project beyond the surface of the *carcase*. Lozenge-shaped bosses are often found on panels. Chairs became so common in the 17th century that even children and servants used them. The upholstered chair usually had straight legs and straight back; there was an open space at the bottom of the back as the upholstering did not start at the seat. Until the Cromwellian time upholstering in finer material had a tasseled border, but in the Commonwealth period, leather (chiefly pigskin) was mostly used and the edges fastened with brass-headed nails. The front brace disappears as better flooring made a foot-rest unnecessary. Cromwellian legs were either turned or rectangular, always straight. Side tables with round tops in two pieces, one of which could be let down or "dropped" by turning a pivoted leg, belong to this day. All Puritan pieces are very sober, simple and strong. Some leather chairbacks were quite low. With the return of Charles II from French exile (Restoration) the style became ornate and French. Stuart furniture legs are typically *spiral* turned, on chairs, tables, drawers, cupboards. Inlays continue in bone, mother-of-pearl, ivory, tortoise-shell. Walnut, solid and veneered, takes the place of oak. In the fashionable marquetry work we find apple, pine, plum, lignum vitæ, pear, yew, box, holly; some is burned or stained to get the desired color. Engraving is sometimes found in the inlay. The so-called "oyster-veneer" is produced with cross sections of walnut branches. The number of drawers in furniture increases as clothing becomes more plentiful. "Court-cupboards" and "bread-and-cheese" cupboards are in most households. Jacobean coffers lose architectural design and take on decoration of acorns, drops as pendants, lathe-turned beads, split-spindles, etc. Geometrical designs prevail. They stand on globular or egg-shaped feet. Small tables are in vogue as tea-drinking came into fashion; the "gate-leg" was a favorite table (it is frequently termed "thousand" or "hundred" legged) because it could be reduced to almost the space of its balustres. The Elizabethan "melon-bulb" protuberance on furniture supports had dwindled to balustre knobs, but now grew into a big ball, half-way down the leg. Cane and open work appear in chairbacks, displacing leather, in late transition pieces. Day-beds are now of walnut.

Queen Anne Period.— In the short reign of William and Mary the only change was in the form of imported pieces. The Queen Anne style continued all through the reign of George I, but only arrived rather late in the queen's reign. Seats had been largely cane-bottomed till now and loose cushions were used on them. The upholsterer in this style did the chief work in the production of furniture to sit on. The stiff, angular wooden seat and back of chairs were no longer common usage. Chairs were built to the shape of the human form and softly padded, seat and back. The same with couches and settees. Seat frames are rounded in front, arms are scroll form and set half-way back to allow for the spreading crinoline. The double chair became a favorite and is called also a "love-seat." "Turned" (spindle) chairs with high backs, called "Windsors," came into use. The "wing-ear" or "grandfather" chair was perfected as an evader of draughts. The *cabriole* leg came into general use now, but was seen also in William and Mary's time. In decoration we see the scallop-shell; and the "claw-and-ball" feet are on fine pieces. Splats appear in furniture-backs. Tables of Jacobean style persist in early walnut examples and the "inverted bowl" appears on balustred legs. Stretchers are carved and "tied" (X form). Inlays are frequent and show great perfection. Early examples of bureaus have an overhanging upper story, but, in general, they are in present-day form by 1710. Chests of drawers show brass drop handles, mostly pear-shaped, and the brass escutcheons are usually openwork. These had three or more drawers on a stand which had or had not drawers. Now from one to five drawers are in the stand. The "high boy" or "tall boy" came into being with 8 to 12 drawers. Cabinets for curios belong to this time in which collectors displayed behind glass doors their bric-a-brac, for Chinese porcelain collecting was a craze.

Georgian Period (1727–1820).— The styles of furniture in use during the reign of George I were those passed over by Queen Anne; this furniture has been styled by some "Early Georgian." To it belongs the "Hogarth" chair and the gilt pieces that stayed in vogue. The period, so full of furniture talent (1735 to 1805), with the achievements of Chippendale, Adam Brothers, Heppelwhite, Shearer and Sheraton has been called "Mid-Georgian." The following period marked by decadence and depraved fashions has been termed "Late-Georgian." William Kent, the architect, included furniture in his work when he returned from his studies of antiques at Rome, but he included the prevailing French styles in Classic work, till his death in 1748. With the brothers Adam decoration conformed rigidly to the Greco-Roman and their styles in furniture were immensely popular from the middle to the end of the century. The Chippendale and Heppelwhite creations were adapted to the Louis XV interiors then so popular. Heppelwhite, Shearer and Sheraton worked to fill interiors in Louis XVI style, in fashion at the end of the century. In the early 19th century Sir William Chambers gained some popularity with his Chinese motifs in furniture. This is the age of mahogany.

Bibliography.— Bajot, E., 'Encyclopedie du meuble du 15e siècle jusqu'à nos jours' (Paris 1900–09); Bayard, E., 'L'Art de reconnaître les styles' (Paris 1913); Benn, R. D., 'Style in Furniture' (London 1904); Binstead, H. E., 'The Furniture Styles' (Chicago 1909); Blake, J. P., and Reveirs-Hopkins, A. E., 'Little Books About Old Furniture' (New York 1912); Burgess, F. W., 'Antique Furniture' (New York 1915); Candee, H. C., 'Jacobean Furniture' (New York 1916); Champeaux, A. de, 'Le Meuble' (Paris 1885); Clouston, R. S., 'English Furniture of Furniture Makers of the 18th Century' (London 1906); Fenn, F., and Wyllie, B., 'Old English Furniture' (London 1909); Foley, E., 'The Book of Decorative Furniture' (New York 1911); Graul, R., 'Das XVIIIte Jahrhundert Decoration und Mobiliar' (Berlin 1905); Guérin, J., 'La Chinoiserie en Europe au 18e siècle' (Paris 1911); Havard, H., 'L'Art dans la maison' (Paris 1884); id., 'Histoire et philosophie des styles, (Paris 1899-1900); id., 'Dictionnaire de l'ameublement' (Paris n. d.); Jacquemart, A., 'A History of Furniture' (London 1878); Hayden, A., 'Chats on Old Furniture' (London 1905); Labarte, J., 'Handbook of the Arts of the Middle Ages and Renaissance' (London 1855); Lambert, A., and Stahl, E., 'Das Möbel' (Stuttgart n. d.); Leixner, O. von, 'Einführung in die Geschichte des Mobiliars und die Möbelstile' (Leipzig 1909); Litchfield, F., 'Illustrated History of Furniture' (London 1907); Macquoid, P., 'A History of English Furniture' (London 1904-08); Molinier, E., 'Les meubles du moyen âge et de la Renaissance' (Paris 1897); id., 'Le Mobilier au 17e et au 18e siècle' (Paris 1898); Moore, N. H., 'The Old Furniture Book' (New York 1903); Morse, F. C., 'Furniture of the Olden Time' (New York 1913); Pollen, J. H., 'Ancient and Modern Furniture and Woodwork' (London 1908); Robie, V., 'Historic Styles in Furniture' (Boston 1916); Ris-Paquot, O. E., 'Le mobilier et objets qui s'y rattachent' (Paris 1893); Singleton, E., 'Furniture' (New York 1911); id., 'The Furniture of Our Forefathers' (New York 1901); Timms, W. H., and Webb, G., 'The 35 Styles of Furniture' (London 1904); Wheeler, G. O., 'Old English Furniture of the 17th and 18th Centuries' (London 1907).

CLEMENT W. COUMBE.

FURNITURE INDUSTRY IN AMERICA, The. The early cabinet-shops of America were like the second-hand repair-shops to be seen to-day in New York, Boston, Philadelphia, and other large cities. A great many cabinet-makers made furniture until late in the 1st century of commercial independence on simple Chippendale lines. Gradually the Empire fashions, which were making themselves felt all over Europe, spread to America, and shapes became heavier and more pretentious, mahogany being used almost exclusively. Heads of animals were also used, and claw-feet became a general feature. Common furniture was heavy and unattractive. The general condition of things at this time was unfavorable to the development of art industries. Little thought was given to progress in the manufacture of furniture and for some years there was a decline. Upon a revival of commerce cabinet-makers changed their style, and began producing a debased rococo style, which did not have the elegance or character of the Louis XV, but was covered with a florid ornamentation in which the only consideration was display. The extravagance of curves and lavish ornamentation brought about a reaction, and toward 1830, following the fashion in England and France, an attempt was made to construct furniture in the Gothic style, but with very unsatisfactory results. The lack of artistic training of the manufacturers who were, as a rule, cabinet-makers or carvers by trade, made it very difficult for them to handle a method of decoration and construction so little appropriate in itself to the requirements of home comfort. This Gothic style of furniture, monumental in appearance, was made to a limited extent only, although its influence is to be noticed on other furniture placed on the market at this time and later. The making of rococo furniture was kept up by a large number of cabinet-makers, the cheaper furniture being for many years made in this style. It was also during this period that steam, applied to cabinet-makers' machinery for the first time in 1815, occasioned a revolution in the manufacture of furniture, bringing labor-saving devices into more general use, and enabling the cabinet-maker to supply the rapidly increasing demand for his product. In 1825, Richardson, of Philadelphia, introduced the circular saw, and Taylor, Rich & Company erected the first mahogany-mill in America, a number of these saws being used there. Ordinary furniture, which until now had been very plain, was covered with endless scroll-work and moldings, produced so easily by the new machines. The manufacturers indulged for a time without restraint in this ornamentation. The use of machinery in shops, and the increased facilities for transportation, wrought a wonderful improvement in the furniture trade; and the cabinet-shop, which had until this time been of small importance and partially engaged in making articles kindred to furniture, suddenly assumed large proportions, and confined itself to furniture only, using in the making of it the new devices which were constantly being brought forth by ingenious inventors. The value of the furniture product in the year 1850 may be estimated at about $15,000,000, and the industry gave employment to 37,000 people, out of a population of a little over 23,000,000. For a long time a great number of hand-shops survived, making to order special high-grade work and they succeeded in impressing their patrons with the idea of the inferiority of machine-made furniture, which at this early stage in the introduction of machinery was not entirely without foundation. The extensive use of machinery in shops had the immediate effect of again changing the style of furniture. Manufacturers looked for a fashion in which they could use their facilities to the best advantage, and at the same time retain the attractiveness of their earlier work. This they found in the Renaissance, which for a number of years superseded all other styles in the best class of furniture.

Up to this time the furniture industry had been confined to the Eastern States, principally in and around Boston; but a number of factories were now started in the West, where situated in proximity to large forests and regions where population and wealth were rapidly increasing, they soon became important factors in the production of furniture in the United States. These factories, equipped with new machinery and using native timber, produced at first a low grade of furniture in which art seems to have been very little considered. Those who wanted more artistic furniture purchased it from the East. The art revival which had taken place in Boston and New York was fostered by increased travel in Europe, where exhibitions were taking place at short intervals in London and Paris. Moreover, the consideration that old furniture was beginning to receive brought forcibly to the people the inferiority of that then made, and manufacturers gave more attention and study to its appearance than before. Trade kept increasing with the general wealth, and in 1860 the production reached $25,500,000; but the number of workingmen employed in this industry, owing to the improvements in machinery, had fallen to 28,000, although the population had then reached almost 31,500,000.

Industries in general were now to receive another blow, on account of the War of the Rebellion. As soon as this conflict was over, the extraordinary activity which had prevailed in military circles was transferred to the industrial field, and from this time on it is by leaps and bounds that improvements can be noted. The furniture trade was in the hands of two classes of manufacturers, one class of whom, having taken the place of the old-handshop workers made high-class work to order, continuing the old traditions, but now using machinery extensively. The other class of manufacturers studied the wants of the people, and produced suitable articles at prices which were within the reach of the masses. It is to them that we are indebted for the gigantic development of the industry, as they placed within the reach of all, strong, ornamental and practical furniture. We have seen that men of taste had recognized for some time that our furniture was inferior to that made at the end of the last century, and had begun to study not only the styles of that period, but also those of the English and French prevailing in the past. As a result we find that a great variety of styles were employed in the productions of the leading firms, who were always striving for novel effects.

A work published in London, England, in 1868, entitled 'Hints on Household Taste,' by C. Eastlake, waged war on modern work, advocated returning to the primitive principles of Gothic construction; and gave positive instructions as to what was right or wrong, not only in the line of furniture, but in draperies, carpets, and other household decoration, as precisely as if the art had been a science. This book was looked upon as a sort of gospel treatise on furnishing, and however much we may at this time ridicule some of the ideas conveyed, it directed the public mind in its search for more artistic surroundings at home. From that time other styles were discarded, and designs in accordance with the newly developed taste took their places. The movement in favor of more perfect construction and the use of straight lines exclusively became general, the stiff appearance being relieved by an abundant use of arches, spindles, turnings, etc. This style allowed the manufacturers to do the greater part of the work by machinery, for which it seemed specially adapted. The increased interest that the public took in furniture developed the trade in an unprecedented manner, the production for 1870 being $68,500,000, or nearly two and one-half times that for 1860. The number of men employed at this time shows a similar increase, being 55,800, out of a population of 38,500,000 people. The Centennial Exhibition in Philadelphia (1876) had a far-reaching influence, especially on western manufacturers, who until this time had not had occasion to compare their products with those of the best manufacturers of America and Europe. This exhibition marks the highest point that the Eastlake or early English was to attain. A number of the most prominent manufacturers of this country had their exhibits made in this particular style. It was quickly taken up by the manufacturers of cheaper furniture, who until then had given very little attention to artistic form, and they are responsible for the enormous quantity of furniture in imitation of this description that can yet be seen in the auction-rooms of large cities. The strife for originality, which was soon to be one of the characteristics of western manufacturers, had now begun to show itself; but an insufficient knowledge of art subjects rendered many of their designs more strange than beautiful, and more noticeably so when they were working on the lines of any given style; but through diligent efforts their designs were steadily improved, and this, in connection with their superior facilities, has secured to them a large part of the eastern trade. The volume of business showed a substantial increase during this decade, although not as large as during the preceding period. The value of the output of furniture for 1880 was $77,845,000 — an increase of 13.5 per cent in value, but a decrease from $1.77 to $1.55 per capita of the population. The wonderful changes which occurred in architecture in the next decade, especially the Romanesque revival due to H. H. Richardson, had a distinct effect on furniture. Richardson himself designed some Romanesque furniture. Furniture manufacturers eagerly welcomed this departure, for the ceaseless demand for new things, as strong then as it is now, obliged them to change their patterns very frequently. Unfortunately, by passing through the hands of manufacturers of cheap furniture, it lost all of its original beauty. During this decade great improvements were made in woodworking machinery, and a large number of new devices were invented. Among them was the carving machine, which enabled manufacturers to ornament even the cheapest kind of furniture. The amount of business done in 1890, large as it was, did not keep up with the increase of population. The value of the product in 1890 was $86,362,685, an increase of 11 per cent over that of 1880, but the amount per capita of population dropped to $1.38 as compared with $1.55 in 1880, and $1.77 in 1870. The International Paris Exposition of 1889 revived a taste for the 18th century furniture, especially of the Louis XV style, which was quickly taken up by the people of the United States. In spite of the seeming difficulty of using machinery in making such work, American manufacturers made and are still making a large quantity of furniture, in that dainty mode, which certainly equals that of the same class made in Europe, and is generally better constructed. All the 18th century styles, French or English, have been and to a certain extent are now used by American manufacturers:—Louis XV, Chippendale, Louis XVI, Sheraton, Hepplewhite, Empire and the Flemish Renaissance.

Since the decline of the Empire style in the first half of the last century manufacturers have been satisfied to copy the styles of the past, with such modifications as conformed to commercial requirements. The public demand for reproductions of old furniture increased to such an extent as to leave little room for originality in their production. Within recent years a strong feeling has developed that the old styles are not in keeping with present ideals and new styles should be evolved to emphasize simplicity of construction, grace of style, beauty of proportion and harmony of color. The Mission style, at first heavy and shapeless, is acquiring more subtle and refined lines, thereby increasing in public favor. The novelty of the last century is a free natural style called Art Noveau. Its introduction to this country from France a few years ago was attended by failure. The market was flooded with goods of inferior make in which the vagaries of this style were mistaken for its distinctive features. The meaningless curves and coarse ornaments of the beginning are being discarded and a refined elegance is now taking their place. The extensive adoption of this style in other art industries warrants the belief that it soon will be a distinctive feature in furniture.

Many of the numerous articles of furniture manufactured are distinctly American. The bureau, the rocking-chair, the folding-bed, the chiffonier, as now made with toilet, and in general most of the combination pieces of furniture made with a view of economizing space in apartments in large cities, are of this class. The American bureau is a combination of the old chest of drawers and the dressing-table, having the drawer-room of the one and the swinging mirror and table-top of the other. This has been imitated in Europe to a limited extent, in the production of what is known as the English dressing-table. As made in this country, the bureau is one of the most practical pieces of furniture used. The rocking-chair, almost entirely unknown in Europe, is found in every home in this country, yet it is difficult to ascertain when it was first put in use. We do not find any mention of it in the descriptions of articles of furniture in the 18th century. The first patent issued for improvements in rocking-chairs is dated as far back as 1830. The folding-bed, in the shape of a sofa, with a box-seat for bedding, has been used in Europe for over a hundred years, but America claims the folding-bed in other forms, such as the wardrobe, the cabinet, the mantel, and the combination; some of these were made as early as 1847. The demand for folding-beds, which reached its climax a few years ago, is now showing a material decline.

The woods used in the manufacture of furniture are varied, and subject to frequent changes. Early in the century, mahogany, maple and black walnut were in favor; then cherry and ash became fashionable; toward 1880, oak, so long forgotten, took a prominent place. At the present time black walnut is almost entirely out of use. Oak has kept its popularity for the hall, the library, and the dining-room. Mahogany, curly birch, and maple are still extensively used; all of them for the bedroom, and mahogany for the dining-room and the drawing-room in the better grades of furniture. The changes in furniture covering have been more frequent and radical than those of the woods. Haircloth and other coverings in use 30 years ago have been superseded by materials more varied in texture and coloring. Their variety is almost endless, and they show, perhaps as much as anything else, the advance that art as applied to furniture has made in this country. The present centres of the furniture industry are, with one exception (Grand Rapids, Mich.), the largest cities, which, with their densely populated suburbs and surroundings, offer large markets. The cities whose productions amount to more than $2,000,000 per annum, in the order of their importance, are: New York, Chicago, Grand Rapids, Philadelphia, Cincinnati, Saint Louis, Boston.

During the past 10 or 15 years there has been a very steady progress towards more refined furniture and to-day the manufacturers of the better grade furniture are producing articles in quantities that a few years ago could only be found at shops making furniture to order by the single piece. The manufacturers of medium and lower grade goods are placing upon the market designs with feeling following the thoughts of some of the earlier masters of the Flemish and English schools, therefore our furniture stores are full of many simple and good pieces which the consumer can buy at very moderate prices. One can furnish a home today which will bear close inspection by the artists at a cost which is within the reach of the more modest incomes. There is to be found some very ugly furniture which is still produced for certain trade, but the desire for this kind of furniture is fast disappearing. The manufacturers all over the country are eager to secure artists and draughtsmen who can lead them forward to better production and choicer class of wares.

During the last 10 years there has been published many readable books and monthly publications which picture the better homes and home furnishings. They have done much to help the people to understand better furniture. We are seeing the demand come very fast for more refined furnishings in all branches of the industry. The day is not far distant when furniture will have the same thought given to its selection as we give to other objects of art that we expect will live and adorn our homes. Furniture should grow in favor as the years pass by.

The manufacturers of to-day have endeavored to keep well abreast of the demand and the keen competition which has always existed has been the means of producing more new things in the past few years than has ever been produced in a like period. In many instances too much has been produced for the sake of getting something new rather than of confining our efforts to really good pieces that prove their worth by age. The semi-annual furniture sales of the manufacturer have been continued up to the present time. The points most prominent for such exhibitions are New York City, Chicago, Ill., Grand Rapids, Mich., and Jamestown, N. Y., the latter coming into prominence within the last five years. This was brought about by the large number of factories located there combining their efforts in erecting a large exhibition building which is open to the dealers during the months of May and November of each year. The selling dates of July and January are maintained at the other points mentioned. Dealers from all over the country assemble at these sales to purchase their six months' requirements. Both the New York and Chicago exhibition buildings show many lines of the cheaper grades of furniture. Both of these cities, however, have many manufacturers of the better grade who exhibit in their local factories. Grand Rapids has for many years stood out very prominently with its lines of bedroom, dining-room and living-room furniture. No market in recent years has shown more marked progress. This market, like New York and Chicago, has many exhibitors whose factories are located in various sections of the country. Six large buildings have been erected for the convenience of these manufacturers to show their product, there being about three hundred who exhibit at these semi-annual sales in Grand Rapids. To-day many kindred lines are shown and one can find in this market almost anything that is required in the furnishing of a home or public building. The quantity of furniture manufactured has greatly increased until the total output in this country averages about $300,000,000.

The manufacture of furniture is so easily undertaken that there are a large number of small companies and but few whose volume exceeds a million dollars per annum. The same method of starting these companies is true today where cabinet-makers rally about them a few men and organize a small company. Furniture factories are located in practically all of the States of the Union, excepting the prairie and mountain districts. The manufacturers of furniture are fast reaching efficiency methods in both manufacturing and selling. Much has been accomplished along this line in the past few years where costs have been reduced and the production is better. The commercial product of to-day consists of furniture largely made of mahogany, American walnut, oak and other woods that can be enameled in various colors and also decorated according to requirements. Other woods are used in some instances and in the better grades the choicest of woods can be found.

The working conditions have been greatly improved, and labor is receiving a much larger compensation than in the past. The majority of furniture factories in the country are working on the 10-hour a day basis. This is true especially with the factories located in the smaller towns. Some, however, have adopted the nine-hour a day basis, Grand Rapids being one of the most prominent centres working on this basis.

The exporting of furniture is still very limited, although certain grades of chairs and office desks have been exported for some years. Just before the World War our South American markets were making purchases from manufacturers of the better quality furniture and from reports received our furniture has proved quite satisfactory in South America. Manufacturers are in a fair way to do much more business there when the shipping conditions between the two countries become more favorable.

During 10 years (1907–17) there developed quite a departure in office and public building furniture, such as desks, tables, chairs, filing cabinets, wardrobes, etc. All of these articles being also made of steels, painted or finished to imitate mahogany. Metal furniture, however, has not come into favor for the home excepting the brass and iron beds, which have been made for many years and continue to be made. These articles, however, have been changed to more refined lines and proportions. Articles for the kitchen and bath-room are also made in metal and are growing in favor.

We are fast becoming lovers of outdoor life and our homes are being built with large porches both open and closed. This calls for a different class of furniture. The demand is supplied quite largely by reed, rattan and fibre-seating furniture, trimmed with bright colors of chintz or cretonne. This character of furniture has increased in demand very materially. The breakfast room is much more common in our modern homes and therefore a bit of color or fancy wood is very appropriate for such furnishings, thereby calling for changes in design to meet new needs.

This industry was affected to a considerable extent by the World War. The furniture business is commonly considered as one of the non-essential industries on account of the inability of the government to supply orders for more than 10 per cent of the output of the woodworking factories of the country. Every manufacturer hoped, however, that his organization could be held together by older men and the women who were fast filling furniture factories. For the duration of the war the manufacturers entered into an agreement with the Conservation Division of the War Industries Board at Washington, to produce no new pieces of furniture and to discontinue special sales seasons of July and January, November and May, and established one sale season a year during the month of May, this sale being held at the various points at the same time. Many other economies were inaugurated. Knock-down construction whenever possible was demanded to save shipping space. Metals and glass were largely conserved owing to the great shortage of the raw product. To conserve capital, the variety of designs was reduced 50 per cent. This conservation program caused some manufacturers to take up other lines of work more essential to winning the war. It also created quite a change in the present method of doing business, and especially after the war. Some factories were unable to stand the strain, and all of the war casualties were not found in Europe.

WM. H. GAY.

FURNIVALL, Frederick James, English scholar and editor: b. Egham, Surrey, 4 Feb. 1825; d. 2 July 1910. He was a graduate of Trinity College, Cambridge, and was called to the bar in 1849. He devoted his life chiefly to the study of early and middle English literature; and he was mainly instrumental in establishing the Early English Text Society, the Chaucer Society, the New Shakespeare Society, the Browning Society, the Wickliffe Society and the Shelley Society. The societies named have given a powerful impulse to English scholarship by their publications, and this was in no small measure due to Dr. Furnivall. For them and for the Roxburghe Club and the Rolls Series he edited numerous works, notably the Six-Text edition of Chaucer's 'Canterbury Tales' (1868–75). Other works of his are 'Early English Poems and Lives of the Saints' (1862); 'Early English Meals and Manners' (1867); 'Book of Nurture' (1867); 'Education in Early England' (1867); 'Bibliography of Browning' (1881); and 'The Fifty Earliest English Wills in Court of Probate' (1882).

FURNIVAL'S INN, an ancient inn of chancery and appanage of Lincoln's Inn. It is named after Sir William Furnival, whose family became extinct in the 14th century. It stood in Holborn and gradually falling into disuse finally ended its history in the 18th century. Consult Pearce, R. R., 'Guide to the Inns of Court and Chancery' (London 1855), and Headlam, Cecil, 'The Inns of Court' (New York 1909).

FURRER, fur'ĕr, **Jonas**, Swiss statesman: b. Winterthur 1805; d. 1861. After studying at Zürich, Heidelberg and Göttingen he became president of the Grand Council of Switzerland in 1839, a position which he again occupied in 1844. In 1845 he received his appointment as president of the Cantonal Diet, and when the new federal constitution went into effect he was elected President of the Swiss Confederation and was thrice re-elected. He wrote 'Das Erbrecht der Stadt Winterthur' (1832).

FURS, fọrs, **FORS**, or **FURANI**, Moslem negroes, whose habitat is in Darfur in eastern Sudan. They are very black, tall and have wooly hair. They have been classed with the Nigritians, the race which once covered the Egyptian Sudan. Their modern history is a continuous record of wars and insurrections.

FURS are articles made from the skins of fur-bearing animals prepared with the hair left on. A fur-bearer, in the language and practice of the fur-trade, is an animal that has a short, fine, soft coat through which grow longer hairs. (For a list of fur-bearing animals and their residence, see FUR-TRADE). This overhair is straight, smooth, somewhat stiff and serves as a protection against cold and wet. The beauty of such pelts as those of foxes and the weasel tribe is due largely to this long overhair, and when it is at its best, in preparation for winter, the animal is said to be «prime.» In some, however, as the otter, beaver and sometimes the skunk the pelt is improved for use by pulling or «plucking» out these long hairs. Conversely, long hairs are sometimes inserted, or «pointed,» into manufactured skins, as in making a fraudulent silver-fox.

The underfur, or «fur» proper, consists of soft, silky, curly filaments. It is usually short and thick, and toward the skin it grows lighter in color. It is barbed lengthwise and hence is capable of felting — whence the value of rabbit-fur in hat-molding. «In a prime pelt,» says Jones, «the underfur is hardly discernible unless the overhair is blown apart. Then the light color of the underfur appears. If it were generally known that the undyed skin is whitish, and that the underfur close to the skin is a light drab, or pale blue color, it would not be so easy to sell dyed skins as 'natural.'»

Two methods are used in taking the pelt off the animal's body and saving it for market. The larger animals, as bear, wolf, wolverine, beaver and others, are regularly skinned and the hides are scraped clean of flesh, stretched on a flat surface and dried in a cool place. Small skins are opened by slitting inside the hind legs, the bones of which are removed, clipping and taking out the tail-bones and then stripping the skin from the body. The pelt, then wrong side out, is stretched by means of hoops or wedged boards fitted to each kind, cleaned and permitted to dry in this stretched form. This is called «casing.» Much of the value of the pelt depends on the care of this original preparation and the subsequent packing for shipment. Sealskins are packed with salt in barrels as soon as flayed.

Dressing and Dyeing.— Until the modern introduction of machinery, the dressing of the «raw» pelt began with the placing of them in a bath of lye. «When the pelt has become soft,» it was prescribed, «the skins are tubbed and then shaved, by passing them over a large knife, and placed in an upright position; they are next buttered, and put in a large tub of sawdust by men half naked, who tread on them for some time . . . rendering the leather soft and supple; they are then beaten out and finished.» The complicated operations of the art, varying with different pelts, are now performed mainly in great factories, and by special machinery. The process in general is as follows: The skins are first dampened on the flesh side and left all night to soften. In the morning they are placed, perhaps 2,000 at once, in a tramping-machine and kneaded for 8 or 10 hours, then taken out and left to soak over night in a mixture of brine and sawdust. The next morning they are fleshed by hand, then stretched and hung up to dry. When thoroughly dry they are again moistened with salt water and left over night. Brushed on the leather side with some animal oil or fat, they are then laid together in pairs, hair side out, and the next day are kneaded again in a tramping machine until perfectly soft and supple, after which they are stretched in every direction.

The next process is cleaning, 300 or 400 skins being placed in revolving drums exposed to steam heat, with sawdust which in time absorbs all their grease. The skins are next incased in a beating-drum, where they are revolved and hammered for two or three hours. On removal they are beaten by hand with rattans, and finally the hair is combed.

Well-dressed furs as clothing furnish a maximum of warmth with a minimum of weight, due to the air entangled among the hairs, excelling any practicable garment of cloth of the same shape. Their durability varies greatly, however. Jones gives a long table exhibiting the comparative value of most furs in this respect. The otters, both land and sea, are the most durable, and are reckoned at 100 per cent. Others follow: Beaver, .90; seal, .75; raccoon, .70; skunk, .70; Persian lamb, .65; martens and sable, .60 to .40; fox, .40; muskrat and opossum, .37; nutria, .27; and others from .25 down to hare or rabbit only .5. These facts should be borne in mind in purchasing any article made of fur.

The dyeing of furs is a distinct branch of the industry which heretofore has been almost wholly in German hands, except that until recently all seal-skins were dyed and otherwise dressed in England. Now, however, much of this preparation is done in Canada and the United States. The Bureau of Manufactures recorded that the value of the seal-skins prepared in this country in 1916 was $74,530.

Almost every sort of fur, raw as well as manufactured, has quadrupled in price during the last 30 years, although with many fluctuations. Coincidently, the demand for, and utilization of, furs in garments, and as trimmings, has enormously increased since the beginning of the present century. Political disturbances in Europe, and especially religious persecution, caused the emigration to western Europe, and to North America, of great numbers of workmen skilled in the preparation and sewing of skins and furs. This influx of comparatively cheap, yet competent labor, and other influences, led the capitalists of the trade, in concert with the controllers of fashion, to stimulate, and then to cope with, an unprecedented expansion in the use of ornamental furs — even in summer. This was followed by the setting up, almost wholly, as is natural, by Russian and Polish Jews, of thousands of small factories in every large town. Meanwhile the decreasing supply of first-class skins, competition resulting from the wide diffusion of business and much doubtful responsibility, and the great demand for showy appearance at a cheap rate, have led to a sad disguising and counterfeiting of materials by means of dyeing, manipulation and the invention of trade-names.

The deceptive misnaming of furs is encouraged by the ignorance of buyers, most of whom are willing to believe it when told by an unscrupulous salesman that a cape or muff offered at a ridiculously small price is true sable or seal or other rare and expensive article. It will be interesting and useful to mention some of the frauds constantly perpetrated — though less so than formerly. Take, for instance, sable. Precisely, it is the pelt of the Siberian marten, of which only about 75,000 skins were received annually previous to 1914, worth wholesale perhaps a million dollars. The price of even a small cape of Russian sables must be reckoned in three or four figures. But experts tell us that most «sables» in the fur-shops are made of dyed skins of the Canadian or pine marten, or of polecat, or mink, or plucked skunk («Alaska sable»), muskrat, marmot, hare or even rabbit. Genuine sealskin now has a price far beyond the reach of ordinary purses; but when the fur-dressers produced a clipped and dyed muskrat pelt that resembled sealskin almost perfectly it could be sold far cheaper — not, however, under its own name. Consequently this popular, and even now, high-priced product is sold as «Hudson Bay seal» (no true fur-seals live or ever did live in Hudson Bay; and the seals that do live there are not used). The fur of the common wild rabbit of Europe and elsewhere is the raw material of «electric seal,» «clipped seal» and «Baltic seal.» The rabbit and hare indeed may become almost anything in the hands of fur-dressers and salesmen. When white it may masquerade as coney, ermine, white fox, «foxaline,» «mock fox» or «chinchilla,» and when dyed may become seal of various trade varieties, sable or French sable, fox, lynx, marten, fisher, chinchilla and «muskrat-coney.» Skunk fur was formerly disguised under more elegant names as Alaska sable, black marten, etc., but its beauty and really excellent quality have become recognized and it is now sold for what it is; and curiously the Australian wallaby (a kangaroo) often figures in the market as skunk. Nutria, the fur of a South American aquatic rodent, is so nearly like beaver and otter, that it ekes out those rare skins without much harm; but it also becomes «seal.» Black domestic cats are valuable as fur-bearers and their coats go to market as «genet,» and the ponies and great dogs of Tibet, Manchuria and western China furnish thousands of shaggy hides to the modern furrier. Finally the demand for furs of high class is being met by breeding in captivity foxes, martens, skunks, Astrakan sheep and other animals yielding valuable pelts.

The United States is not only a large producer, but the greatest consumer of furs. Our export of skins in 1916 were valued at $9,288,786, and our imports of furs and fur-manufactures at $16,891,699.

ERNEST INGERSOLL.

FÜRST, Julius, German scholar: b. Zerkowo, Posen (Prussian Poland), 12 May 1805; d. Leipzig, 9 Feb. 1873. He was of Jewish parentage, and at an early age he had a remarkable knowledge of Hebrew literature, Old Testament Scriptures and Oriental languages. In 1825, after having studied at Berlin, he took a course in Jewish theology at Posen. In 1829, after having abandoned his Jewish orthodoxy, he went to Breslau, and in 1831 to Halle, where he completed his studies in Oriental languages and theology. In 1833 he entered journalism in Leipzig, later securing a position as tutor and lecturer in the university there, from which position he was promoted in 1864 to the chair of Oriental languages and literature, a post he filled with great distinction until his death. His works, especially those on the Semitic languages, are of great value, and among the most important may be mentioned 'Lehrgebäude der aramäischen Idiome' (1835); 'Concordantiæ librorum Sacrorum veteris Testamenti Hebraicæ et Chaldaicæ' (1837–40); 'Bibliotheca Judaica' (1849–63); 'Hebräisches und Chaldäisches Handwörterbuch' (1851–61); 'Geschichte des Karäerthums' (1862–65); 'Geschichte der biblischen Litteratur und des jüdisch-hellenistischen Schrifttums' (1867–70). From 1840–51 he edited *Der Orient*. He compiled 'Bibliotheca Judaica' (1849–63).

FURST, William, American composer and conductor: b. Baltimore, Md., 25 March 1852. He studied music in his native town and was a church organist at the age of 14. His comic opera 'Electric Light' was produced and conducted by him in 1878 and for the five seasons following he received engagements as conductor of opera. He became musical director of the Tivoli Theatre, San Francisco, in 1884. His opera 'She' ran for nine weeks there, and was produced for two seasons in New York. His chief productions are 'Theodora' (1888); 'The Isle of Champagne' (1891); 'Honeymooners' (1893); 'Princess Nicotine' (1893); 'The Little Trooper' (1894); 'Ghismonda' (1894); 'The Merry World' (1895).

FÜRSTENBERG, PRINCE **Maximilian Egon zu,** German noble: b. 1863. An intimate friend and adviser of the German emperor the prince bears territorial titles for Prussia, Austria, Hungary, Württemberg and Baden, and by virtue of this he has a seat in the Houses of Lords in all five countries. His principal seat is at Donaueschingen, near the source of the Danube, where he owns a magnificent castle and great deer forests. The Kaiser frequently visits there, and the prince invariably accompanies the emperor on his hunting expeditions and Norwegian trips. He became Imperial Chancellor in October 1918. He possesses vast forests, coal mines, hotels and breweries.

FÜRSTENBERG, a mediæval principality, now comprised in Baden, Hohenzollern and Württemberg. The name is perpetuated by the princely house of Fürstenberg of Austria, by the landgraves of Fürstenberg of Lower Austria and by the counts of Fürstenberg in Rhenish Prussia and Westphalia. Consult Tumbült, G., 'Das Fürstentum Fürstenberg' (Freiberg 1908).

FÜRSTENWALDE, für'stĕn-väl'dĕ, Prussia, town in the province of Brandenburg, on the Spree, 30 miles southeast of Berlin. It contains several churches, a gymnasium and many public monuments. It owns a neighboring forest 20 square miles in extent. Its industries include woolen manufactories, machinery, bricks, glass, alcohol and electric supplies. The town obtained municipal privileges as early as 1285. Pop. 23,000.

FURTADO, foor-tä'dō, **Francisco José,** Brazilian statesman: b. Oeiras (Piauhy), 13 Aug. 1818; d. Rio de Janeiro, 23 June 1870. After graduating from the Academy of Law at Caxias and serving for some time as judge, he entered politics and rose to be leader of the Liberals. In 1847 he was elected deputy and reelected several times. In 1856 he was elected president of the new province of Amazonas, remaining such until 1859, when he was made Minister of Justice. In 1864 he was elected senator, but held that position for a few months only, and in August 1864 was made Premier and Minister of State, in which position he did much toward the establishment of a good monetary system. During his term of office as Minister of State the dispute with Uruguay was settled and war between Brazil and Paraguay was declared. In 1870 he was again a member of the Senate and as such, being an opponent of slavery, exerted all his influence in behalf of legislation looking toward its final abolition.

FÜRTH, Bavaria, town situated at the confluence of the Pegnitz and the Regnitz, five miles northwest of Nuremberg, and 950 feet above sea-level. It has broad streets and is entirely modern in appearance, has many fine churches, a synagogue and a modern Rathaus. It manufactures mirrors, mirror-frames, bronze and gold leaf, toys, haberdashery, optical instruments, pencils, silver work, machinery, leather goods, etc. It has a large trade in these and in hops, wool and coal. A large annual fair is held here in October. Fürth was a Vogtei for some time under the burgravate of Nuremberg; in 1314 it passed to the bishops of Bamberg; it was besieged by Gustavus Adolphus in 1632, and two years later it was pillaged and burned by the Croats. It extended tolerance to the Jews and in great part owes its commercial prosperity to them. It passed to Bavaria in 1806 and was chartered in 1818. Pop. 66,500.

FURTWÄNGLER, Adolf, German archæologist: b. Freiburg, 1853; d. 1907. He received his education at Freiburg, Leipzig and Munich; took part in the excavations at Olympia in 1878–79, and in 1884 was made professor of archæology at the University of Berlin. After 10 years in Berlin he removed to Munich. At Ægina he conducted excavations in 1901 and two years later similar operations at Orchomenos. He was universally recognized as an expert on vases and ornaments of antiquity. He published 'Plinius und seine Quellen über die bildenden Künste' (1877); 'Meisterwerke der griechischen Plastik' (1893; English trans. 1894); 'Ueber Statuenkopien im Alltertum' (1896); 'Die antiken Gemmen' (1900); 'Griechische Vasenmalerei' (1900–04), with Reichold; the catalogue, 'Beschreibung der Glyptothek König Ludwig I zu München' (1900); 'Ein hundert Tafeln nach der Bildwerken der konigliche Glyptothek zu München' (1903); abridged edition of 'Meisterwerke der griechischen Plastik' (1908; translated into English by Taylor, London 1914).

FURY AND HECLA STRAIT, in the Arctic region, lat. 70° N., separates Melville Peninsula from Cockburn Island, and connects Fox Channel with the Gulf of Boothia. It was discovered by Parry (q.v.) in 1822 and named after his ships.

FURZE, fėrz, Anglo-Saxon *fyrs Ulex,* a genus of very branched and thorny shrubs with linear sharply pointed leaves, solitary flowers and two-lipped calyx, belonging to the order *Leguminosæ,* sub-order *Papilionaceæ.* The common furze (*U. europæus*), also called whin and gorse, is abundant in many parts of southern Europe and in Great Britain, although not reaching any considerable elevation and often suffering from the frost of severe winters. It affords a wholesome fodder, especially when young, or when the thorns are artificially bruised, and is grown often on dry and barren hillsides not fitted for other forage crops. A double flowering variety is grown in gardens. Furze is sometimes used as a sand binder and it frequently acts in this capacity of its own accord.

FUSAGASUGÁ, foo'sä-gä-soo-gä', Colombia, town in the department of Cundinamarca, 25 miles distant from Bogotá, the capital, in a southwesterly direction. It has extensive coffee interests and is a favorite summer resort of the inhabitants of Bogotá, its elevation of nearly 6,000 feet making it most salubrious. Pop. 12,000.

FUSAN, foo-sän', or **PUSAN,** Korea, seaport on the south shore, about five miles from the embouchure of the Nak-Tong, at the southern end of the Seoul Railroad, 285 miles south of Seoul. In 1876 a treaty was concluded with Japan which permitted the Japanese to trade in the port. It consists of two towns, old and new Fusan; the older portion being the native town with about 5,000 population, the new inhabited by Japanese. Under the Japanese régime great improvements have been made; waterworks, lighting systems, roads, streets, harbor, etc., constructed or improved. It has a good harbor protected by several islands. It has steamer communication with Nagasaki and other ports in Japan, also with Shanghai, Port Arthur and Vladivostok. The ruling authority is a prefect appointed by the governor at Seoul. There are now about 20,000 Japanese at Fusan. Hides, beans, fish, whale meat and oil and rice are the chief exports, and cotton, petroleum and Japanese manufactured goods form the bulk of the imports, which total about $6,250,000 annually, and are double the value of the exports.

FUSARO (foo-sä'rō) **LAKE,** Italy, lake in the province of Naples, in ancient Campania, one-half mile west of Baia, and about one mile south of the acropolis of Cumæ. It is the Acherusia Palus of the ancients and is connected with the sea by two canals. It may have been the harbor of Cumæ at an early period. Along its shores are the remains of numerous villas. Oyster cultivation is carried on extensively. Consult Beloch, J., 'Campanien' (2d ed., Breslau 1890).

FUSE, a device employed for firing explosives. In mining, quarrying and in military and naval mining operations there is used the "Bickford, safety running" or "tape" fuse which consists of a tubular cord of cotton or hemp that has been rendered slowly combustible, the cavity in the centre of the cord being filled with a slow-burning gunpowder composition. To make the fuse firm and hard, so as to prevent its being cut by the sharp edges of the rock during tamping, the outside of the cord is served with a covering of strong twine, which is wound about it at nearly right angles to the direction of the twist of the cord by the process called countering. To protect the powder from moisture, the wrapped fuse is immersed in a bath of heated varnish composed of glue, soap and whiting. Finally, to prevent the surfaces of the fuse from sticking together when coiled they are coated with dry whiting, bran or powdered soapstone. The fuse described is known as "single fuse" and, as the varnish used is not waterproof, this fuse is only suitable for use in dry ground. In wet ground, a fuse is used which is made by coating the countered cord with tar or resin varnish and then, before the varnish is quite set, countering it with tape and again coating it with varnish. This is known as "taped fuse." When the fuse is to be subjected to especially severe treatment, it is provided with a double coat of twine or thread and is known as "double fuse." The varieties in use are "common hemp fuse"; "common cotton fuse"; "white fuse"; "superior mining fuse"; "single-taped fuse"; "double-taped fuse"; "triple-taped fuse"; "small gutta-percha"; "large gutta-percha"; "small gutta-percha taped" and "large gutta-percha taped." Running fuse comes in lengths of about 50 feet, and, when properly made, is so uniform in quality that it can be depended upon to burn at the rate of three feet per minute. This is important, as it is necessary for the safety of the operator. The fuse should be stored in a dry place so that the powder core may not become damp; and, if so treated, it will retain its efficiency until the varnish has lost all its essential oils and become dusty. Care must be taken not to touch the tape with any oily or greasy matter, as this penetrates through the varnish to the powder core and affects the rate of burning. The fuse should not be roughly handled, as pinching and squeezing alter the rate at which the powder burns. Care should be exercised in opening out a coil which has become stiff through age or exposure to cold weather, for the fuse is then brittle, and if the covering is cracked by sudden and violent unrolling the fuse becomes unfit for use. If there be any doubt as to the behavior of a coil of fuse a piece one foot long should be taken and its rate of burning timed.

Although in firing single charges, safety fuse answers admirably, where several charges are to be fired simultaneously, the safety fuses are connected together by "instantaneous fuses." These consist of a strand of quickmatch enclosed in hemp or flax and several layers of gutta-percha and tape, or of a core of guncotton enclosed in a leaden tube. Besides these nitroglycerine compositions have been proposed by Quentin and Nobel, and one containing mercuric fulminate by Philip Hess. Within recent years it has become the practice to enclose trinitrotoluene (T. N. T.) in leaden tubes for use as a fuse to be exploded by a detonator. Such fuse is now put upon the market under the name of "cordeau detonant," and is meeting with much favor in blasting with "high" explosives.

In naval and military operations, and for simultaneous blasts in mining and quarrying, "electric fuses" are preferred to running fuses. These are gunpowder "igniters" or fulminate "detonators," that are fired by electricity. They are classified as "low tension fuses," designed for use with strong currents of low potential, from primary or secondary batteries, or from dynamo-electric machines; "medium tension fuses," for use with magneto-electric machines which generate currents of medium potential, and "high tension fuses," for use with condensed sparks capable of traversing a sensible air space. The use of the word tension is not warranted by the present condition of electrical science, but it has become technical in this art. To-day, only low tension electric fuses are employed and they are described under DETONATORS (q.v.).

Fuses are employed in ordnance for exploding shell and they may consist of a compressed core of gunpowder enclosed in a tube of wood or metal, or of a fulminating composition or of both. They are known as "nose fuses" when put in the front end or "nose" of the conical pointed shell, or "base fuses" when inserted in the lower end or base of the shell. They are known as "time fuses," when they are planned to burn a certain length of time after they have become ignited, before they set fire to the explosive charge in the shell; "percussion fuses" when they are set in operation by the impact of the shell against an object after it has been projected from the gun. They may act instantaneously in firing the charge in the shell, or there may be a column of compressed powder interposed between the charge of explosive in the shell and the fulminating composition which is fired by impact. As sometimes a second or more intervenes between the striking and the bursting of the shell, these are styled «delayed action fuses.» They may be used with armor piercing shells designed to penetrate armor and burst within the ship. In time fuses, used with spherical shell, the powder in the fuse used to be ignited from the flame of the burning charge with which the shell was propelled from the gun. In modern time fuses there is a metal cylinder which serves as a hammer placed within the fuse case and held in place by brittle pegs of metal, or by a number of small balls. When the shell containing such fuses is fired, the inertia causes the hammer to strip from the pegs and set back toward the base of the shell, or, if it be a shell from a rifled gun, the centrifugal force causes the balls to fly outward and release the hammer. When the shell strikes, and is arrested in its flight, the hammer moves forward, strikes a percussion cap and fires the charge.

«Chemical fuses» have been used in firing gunpowder mines and torpedoes. As an example of these we cite the mixture of cane sugar and potassium chlorate used in the Harvey torpedo. Above a column of this mixture was placed a small glass bulb filled with concentrated sulphuric acid, the whole being enclosed by a soft copper cover projecting from the torpedo. When this cap was struck, it collapsed and broke the glass bulb, and, as the sulphuric acid came in contact with the mixture of sugar and chlorate, the latter burst into flame and ignited the powder in the torpedo. Such fuses have been used by anarchists in infernal machines and they have ascertained the rate at which the acid would eat through sheets of bibulous paper so that by interposing a sufficient number of sheets of paper they could set the train in operation and get safely out of the way before the machine exploded. Fuses, consisting of columns of compressed gunpowder composition, are used in pyrotechny by which to ignite the charges in rockets, bombs, roman candles and other devices. By their use the operator is enabled to get to a safe distance after igniting the device before it functions fully.

Fuses are used in «electrical installations,» but these are of an entirely different character from the above. They consist of strips of metal of low fusibility which are interposed, in electric lighting and other circuits, between the generator and the lamp, or other device, to prevent damage to the device by an excess of current. When the load is greater than is desired the current heats the fuse to its fusion point, when it melts and cuts out the circuit. See GUNPOWDER; EXPLOSIVES.

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FUSED QUARTZ. See ELECTROCHEMICAL INDUSTRIES.

FUSEE, fū-zē', in clock and watch making, is the conical pulley used in connection with the main spring, to equalize the power of the latter, so that the watch may run regularly. The spring coiled within the barrel, when fully wound up and at its greatest tension, draws on the part of the chain wound on the smaller portion of the fusee. The first wheel of the watch or clock is attached to the fusee, and as the latter unwinds by the gearing motion in the watch, the spring also uncoils and loses a part of its tension; as this proceeds, the chain draws on a larger portion of the fusee, and attains an increased leverage on the latter to counterbalance the decreased power of the spring.

FUSEL OIL, an injurious and exceedingly objectionable constituent of improperly prepared distilled liquors (q.v.), consisting of an indefinite and variable mixture of the amyl alcohols (see AMYL) with certain other alcohols and ethers, and certain organic acids and their esters. Fusel oil usually contains butyl and propyl alcohols. It comes over in the later parts of the distillate, and may be separated from ethyl alcohol (in large measure at least) by resort to fractional distillation.

FUSHIMI, foo-shē'mē, Japan, seaport town in the province of Kioto, southern coast of Hondo, on the right bank of the river Uji-gawa, which serves as a trade outlet and depot for Kioto, Otsu and Nara, and is connected by steam service with Osaka. It is noted as the place where a battle occurred between the Imperialists and the adherents of the Shogun in January 1868. Pop. about 22,000.

FUSIBLE METAL, or **FUSIBLE ALLOY,** any alloy, or metallic mixture, which melts at a comparatively low temperature, that is, below the melting point of tin (442° F.). (See ALLOY; AMALGAM; BISMUTH; CADMIUM). Fusible metals are either binary, ternary or quarternary alloys of lead, tin, bismuth and cadmium. These metals, constituting what is known as «the fusible group,» form simple alloys, which consist of practically pure metals and eutectics. As eutectics have a lower melting point than either of their components, we may, by combining these components in the proportion necessary to form the eutectic, obtain alloys whose melting point is much lower than any of the combined metals. The eutectic of three metals melts at a lower point than that of two metals, and the eutectic of four metals lower than that of three.

The alloy known as Wood's Metal, or Wood's Alloy melts at the lowest temperature of all the fusible alloys — 145° F. Its composition is: tin, 4 parts; lead, 4 parts; bismuth, 8 parts; and «a little» cadmium. Other fusible alloys melting at very low temperatures are constituted as follows: (1) lead, 25 per cent: tin, 12.5 per cent; bismuth, 50 per cent; cadmium, 12.5 per cent — melting at 150° F.; (2) lead, 26.7 per cent; tin, 13.3 per cent; bismuth, 50 per cent; cadmium, 10 per cent — melting at 153° F.; (3) lead, 26.7 per cent; tin, 14.8 per cent; bismuth, 52,2 per cent; cadmium, 7 per cent — melting at 156° F. (See BISMUTH). Fusible metals are used in the arts for many purposes. Automatic sprinklers, for example, are capped with alloys of this sort, which are chosen so as to have melting points that are higher than any temperature that would normally occur in the room that is to be protected. If a fire breaks out, however, the abnormal rise of temperature so produced causes them to melt, the water in the sprinkler pipes being thereby released and the fire extinguished.

Fusible metals have also been used quite generally in the manufacture of 'fusible plugs,' for the protection of steam boilers; such plugs being screwed into the boiler at the height which is considered to be the lowest limit to which the water level in the boiler can be allowed to descend with safety. So long as the inner end of the plug is covered with water, the plug itself is thereby kept too cool to melt under the influence of the furnace gases; but when the protecting action of the water is removed by the water level descending below the safety limit, the hot furnace gases melt the material of the plug and the steam in the boiler escapes. Fusible plugs are excellent appliances and in fact they are required by law in some of the States. There is no advantage in filling them with an alloy, however, because in any event the alloy must have a melting point higher than that of the steam that the boiler is to generate (365° F., for a gauge pressure of 150 pounds per square inch), and pure tin, with a melting point of 442° F., is entirely satisfactory for the purpose. Indeed, tin is far superior to any alloy for this purpose, because its melting point remains sensibly constant for an indefinite time (so long as oxidation is prevented), while the melting points of alloys that are continuously exposed to heat for considerable periods become quite uncertain and are often found to be far higher than when the alloy is freshly prepared. The eutectic alloy of lead, tin and bismuth expands at the moment of solidification. It is therefore of value in making metallic casts of substances which will not endure the heat of molten single metals.

FUSIBLE PLUG. See FUSIBLE METAL.

FUSIDÆ, fū'sĭ-dē, a family of gastropod mollusks, by some conchologists regarded as only a genus (*Fusus*) of the family *Fasciolariidæ*. In either case it is a world-marked group allied to the turban-shells and volutes in structure, but having a long, more or less spindle-shaped, comparatively thin shell, with a very long canal. The animal is closely similar in its soft parts to a whelk or a murex. The family contains the genera *Fasciolaria, Clavella, Latirus*, etc., but interest centres chiefly on the genus *Fusus*, of which many species are known in various parts of the world and which goes back to Cretaceous time in geological history. North American species are inconspicuous, but some of the several kinds found upon the coast of Great Britain are highly valued by collectors of shells and constantly sought for by fishermen who bring them up in their dredges from time to time. The «red-whelk» or «roaring buckie» of Scotland is a species (*F. antiquus*) made famous in folklore and by Wordsworth's poem; it is extensively eaten in various parts of Great Britain and along the continental coast. In Zetland its shell was formerly used by the peasantry as an oil lamp. *F. proboscidialis* is one of the largest of mollusks.

FUSING POINT. See FREEZING POINT; MELTING POINT.

FUST, or **FAUST, Johann,** German pioneer printer and associate of Gutenberg: date of birth unknown; d. about 1466. He appears to have been a money-lender or banker; was shrewd enough to see the possibilities of gain in Gutenberg's printing apparatus. He financed the latter's undertaking but when Gutenberg was unable to make repayments, he sued him and seized enough of the printing outfit to cover the mortgage. With his son-in-law, Peter Schöffer, he carried on printing at Mainz; the first publication was a 'Psalter' (14 Aug. 1457), a folio of 350 pages, the first printed book with complete data and with initials printed in red and blue from two-piece types. At the capture and sack of Mainz in 1462, the printers were dispersed and their secret became common property. See GUTENBERG; PRINTING.

FUSTEL DE COULANGES, fos'tel dẹ koo-länzh', **Numas Denis,** French historian: b. Paris 1830; d. Massy 1889. He was educated at the École Normale and at the French School at Athens. After his return to France he became professor of history at Amiens and later at Paris. He received the degree of doctor in 1858, and soon after became professor at Strassburg. After the war of 1870 he returned to Paris, where he taught at the École Normale; became in 1875 member of the Academy of Moral Sciences; succeeded Geffroy in the faculty of letters at Paris, and in 1878 became professor of mediæval history there. From 1880 to 1883 he was director of the École Normale; returned to the Sorbonne in 1884 and remained until 1888. He published 'Mémoire sur l'ile de Chio' (1887); 'Polybe ou la Grèce conquise par les Romains' (1858); 'La Cité antique étude sur le culte, le drait, les institutions, de la Grèce et de Rome' (1864); 'Histoire des institutions politiques de l'ancienne France' (1875–89); 'Recherches sur quelques problèmes d'histoire' (1885). Consult Guirand, 'Fustel de Coulanges' (Paris 1897).

FUSTIAN, named after Fustat, a suburb of Cairo, where the material originated, (1) a species of cotton cloth similar to velvet, having, in addition to the warp and weft, a species of pile consisting of other threads doubled together, which are thrown up in ridges and conceal the groundwork of the fabric. When in the loom, this pile presents the appearance of a set of loops. These are cut in two and sheared down, and when polished and finished, present an evenly ribbed surface on the exterior. The best fustians are known as cotton-velvet and velveteen; besides these there are moleskin, corduroy, and several other kinds. (See WEAVING). (2) In literature, fustian signifies a forced, bombastic style of writing, abounding with metaphors or other rhetorical figures. Consult Passelt, 'Technology of Textile Design' (Philadelphia 1895).

FUSTIC, name of certain kinds of dyewood, which yield a yellow color, capable of being chemically changed to other hues, as brown, green, etc. One variety (*Chlorophora tinctoria*) is a handsome tree of the West Indies, Central and South America; is sometimes used as a cabinet wood, but principally as a dyewood because of its large content of yellow. Another variety is the *Rhus cotinus*, known in commerce as «young fustic.»

FUTA-JALLON, foo'tä zhä-lôn', West Africa, a region in central French Guinea, extremely mountainous, and remarkable for the romantic beauty of its scenery; and the source of the rivers Senegal, Gambia, Niger, etc. Large herds and flocks are pastured, and the soil produces in abundance bananas and other fruits, besides coffee, maize, rice, cotton and numerous palm trees, which furnish dates, wine and oil. The region has an area of about 42,500 square miles and since 1902 has been subdivided into four districts for administrative purposes. The native princes are called almamys, and rule each for two years, subject to the edicts of a council of nobles. The French protectorate dates from 1893. Pop. 700,000. Consult De Sanderval, 'La conquête du Fouta-Djallon' (Paris 1899) and Machat, 'Les rivières du sud et le Fouta-Djallon' (ib. 1906).

FUTA-TORO, foot'ạ.tō'rō, West Africa, a territory in the northern part of French Senegal. It has a population estimated at 125,000, chiefly Fulahs. The soil is fertile and much of the country is covered with tamarind forests. Iron is mined in considerable quantities.

FUTHARK, foo'thôrk, the Runic alphabet which derives its name from the first six letters, *f, u, th, a, r, k,* and is applied to all the systems of phonetic signs of the Teutonic stock, for the same reason as those of classical derivation are called «alphabet» or «abecedarium.» They occur in the same order in Old German, Gothic, Anglo-Saxon and Northern Runes, with a nomenclature in all of them borrowed from trees and other familiar natural objects, suggestive of the derivation of the series of phonetic symbols from a primitive system of pictorial writing. See ALPHABET; RUNIC CHARACTERS.

FUTURE ESTATE, a landed estate of which a person is to become possessed at some future time. In England under the common law the number of such estates was very limited until the reign of Henry VIII, when, in 1535, new classes of future estate were rendered possible by legislation. In England many legal distinctions still remain, such as executory devise, springing use, shifting use, etc., but in very many of the United States all future estates are placed on the same basis so that future estates of all kinds may be created directly by deed as well as by last will and testament. It is also possible to create future estates or interests in personal property as well as in real. All future estates of a contingent character are subject to the rule against perpetuities, which makes void any interest which is not to vest within a lifetime, and 21 years after the creation of the future estate.

FUTURE LIFE. The purpose of this article is not to discuss the varying conceptions of a future life which have been believed and taught through the many generations of human existence. It is not an attempt to trace the history or development of the doctrine of a future life. It is no part of the plan to prove or disprove the matter of continued existence after death or any particular theory thereof, nor to disclose the ground on which this belief has been built. All that is attempted is to present, as fully as space will allow, a summary of this belief as held and expressed by fairly representative minds in all generations. To record every shade of difference, or to quote from authorities in each of the different religious movements is impossible on account of the length to which this article would run. By a series of carefully selected quotations it is hoped to enable the reader to get a hint of what men in different nations and periods of human history have thought on this unceasingly important matter.

Prehistoric.— In the prehistoric period of human life there is in the nature of things no written record of man's belief concerning the future or anything else. The evidence dug up from the burial places of very ancient man is such as to convince any one that in the remote periods of human existence man believed that death of the body was not the end of life. It was believed that the spirit of man lived on; that it often returned to the place of its earthly existence; that it knew those who still lived on earth. It is not at all certain that all primitive races had this belief.

Pre-Christian.— The earliest records known in which man has tried to express his ideas of the future are not easy to understand. It is far from easy to select sentences that express the idea with any clearness.

ASSYRIA.

The future was frequently spoken of as «The land from which there is no return,» and in the 'Izdubar legends,' we read, «Formerly Pir-napistim was of human nature, now Pir-naptistim and his wife must be like the gods.»

EGYPT.

The tombs of Egypt have yielded considerable material on this subject; a 26th century B.C. inscription on a tomb reads:

«Now I caused that I should be buried in the same tomb with this Zau (His father's name) in order that I might be with him in the same place; not, however, because I was not in a position to make a second tomb; but I did this in order that I might see this Zau every day, in order that I might be with him in the same place.»

During the Osirian period the Egyptian dead are identified with Osiris, which explains the following from Pyramid Texts:

"As surely as Osiris lives, so shall he live also;
As surely as Osiris did not die, so shall he not die.
As surely as Osiris is not annihilated, so shall he too not be annihilated."

«When thou hast triumphed over thy present, Re and Horus will provide a ladder for thee; one of them shall stand on this side and one on that, and thou shalt mount up to heaven. The gate of heaven will open to thee, and the great bolts will draw back for thee. There thou findest Re stationed . . . he takes thee by the hand and leads thee into the sanctuary of heaven, and sets thee upon the throne of Osiris»;

From the 'Book of the Dead':

«The blessed dead has his place in the Hall before the great god and he knows every great god . . . He goes out into the field of Earu. There is given to him cakes and bread and fields of barley and spelt seven cubits high. The servants of Horus gather in the harvest, and he eats of this barley and this spelt.»

On Egyptian Tombs (2,000 B.C.) we find:

«May thy soul attain to the Creator of all mankind . . . These have found grace in the eyes of the Great God. They dwell in the abodes of glory, where the heavenly life is led. The bodies which they have abandoned will repose forever in their tombs, while they will enjoy the presence of the Great God."

It was believed that the dead go to the lower world and occupy vast caverns thro' which the sun passed during his night absence:

"The departed, who are in their halls, in their caverns, praise the sun; their eyes are opened, their heart is full of felicity when they behold the sun; they shout for joy when his body is over them."

PERSIAN.

We read in the 'Prayer to the Angels' (Yazatas) recited in last death rites:

"O victorious and holy Srosh, we have removed (N. or M.) from the earth, Spendarmad, and have committed him (or her) to the stone Ayokhshust. O angel Srosh, we turn our backs upon him (her), but do thou turn thy face towards him (her); into thy keeping we have given him (her); do thou take his (her) hand. . . . O, Srosh, Mihr, and Rashn the Just, we have delivered him (her) into your keeping; take his (her) hand and lead him (her) to the abode of our forefathers and the righteous and the pure. So be it in accordance with the will of the Angels and Archangels; so be it, so, verily let it be."

In the 'Zendavesta (589 B.C.) *is found:*

"The man who has constantly contended against evil, morally and physically, outwardly and inwardly, may fearlessly meet death; well assured that radiant Sprits will lead him across the luminous bridge into a paradise of eternal happiness, . . . Souls rise from the graves will know each other, and say, That is my father, or my brother, my wife, or my sister."

"What is the world? It is simply a halting place with two gates. By the one ye enter; by the other ye depart."

From Airyama Prayer:

"In the earth shall Ahriman hide,
In the earth the demons hide,
Up the dead again shall rise,
And within their lifeless bodies
Incorporate life shall be restored."

The Pahlavi Texts have:

"In that assembly (the risen dead) every one sees his own good deeds and his own evil deeds; and then, in that assembly, a wicked man becomes as conspicuous as a white sheep among those which are black." The heavenly work being completed "all men become of one voice and administer praise to . . . the merciful Lord, who makes the final retribution, and who will at the end deliver the wicked from hell and restore the whole creation in purity."

HINDU.

The 'Ancient Vedas' (c. 1500 B.C.) *state that:*

"The God of the Dead waits enthroned in immortal light to welcome the good into his kingdom of joy: to the homes he had gone to prepare for them, where the One Being dwells beyond the stars."

The Bhagavadgita (c. II), *The deity said:*

"You have grieved for those who deserve no grief, and you speak words of wisdom. Learned men grieve not for the living nor the dead. Never did I not exist, nor you, nor these rulers of men: nor will any of us ever hereafter cease to be. . . . For the one that is born death is certain; and to one that dies, birth is certain."

Dhammapada (Buddhist):

"The evil-doer mourns in this world, and he will mourn in the next world: in both worlds has he sorrow.

"The virtuous man rejoices in this world, and he will rejoice in another world: in both worlds hath he joy.

"As kindred, friends, and dear ones salute him who hath travelled far and returned home safe, so will good deeds welcome him who goes from this world and enters another."

The Satapatha-Brahamana (Pt. IV, Third Brahmana):

"Henceforward no one shall be immortal with the body: only when thou shalt have taken that (body) as thy share, he who is to become immortal either through knowledge, or through holy work, shall become immortal after separating from the body. Now when they said, 'either through knowledge or through holy work' it is this fire-altar that is the knowledge, and this fire-altar that is the holy work.

"And they who so know this, or they who do this holy work, come to life again when they have died, and, coming to life, they come to immortal life. But they who do not know this, or do not do this holy work, come to life again when they die, and they become the food of him (Death) time after time."

Buddhist Suttas:

"The devout Kakudha, Ananda, by the complete destruction of the five bonds that bind people to these lower worlds of lust, has become an inheritor of the highest heavens, there to pass entirely away, thence never to return."

CHINESE.

Buddhist Scriptures:

"Man never dies. The soul inhabits the body for a time, and leaves it again. The soul is myself: the body is only my dwelling place. Birth is not birth: there is a soul already existent when the body comes to it. Death is not death: the soul merely departs, and the body falls. It is because men see only their bodies that they love life and hate death."

The writings of Kwang-tze (Book XVIII, 4):

"When Kwang-tze went to Khu, he saw an empty skull, bleached indeed, but still retaining its shape. Tapping it with his horse-switch, he asked it, saying, 'Did you, Sir, in your greed of life, fail in the lessons of reason and come to this? Or did you do so, in the service of a perishing state, by the punishment of the axe? Or was it through your evil conduct, reflecting disgrace on your parents, and on your wife and children? Or was it through your hard endurances of cold and hunger? Or was it that you had completed your term of life?'"

"Having given expression to these questions, he took up the skull and made a pillow of it when he went to sleep. At midnight the skull appeared to him in a dream, and said, 'What you said to me was after the fashion of an orator. All your words were about the entanglements of men in this life-time. There are none of those things after death. Would you like to hear me, Sir, tell you about death?' 'I should,' said Kwang-tze, and the skull resumed: 'In death there are not (the distinctions of) ruler above and minister below. There are none of the phenomena of the four seasons. Tranquil and at ease, our years are those of heaven and earth. No king in his court has greater enjoyment than we have.' Kwang-tze did not believe it, and said, 'If I could get the Ruler of our Destiny to restore your body to life with its bones and flesh and skin, and to give you back your father and mother, your wife and children, and all your village acquaintances, would you wish me to do so?' The skull stared fixedly at him, knitted its brows, and said, 'How should I cast away the enjoyment of my royal court and undertake again the toils of life among mankind?' »

SIAM.

Buddhist Scriptures:

«The effect of water poured on the root of a tree is seen aloft in the branches and fruit; so in the next world are seen the effects of good deeds performed here.»

CEYLON.

Buddhist Scriptures:

«There are treasures laid up in the heart,—treasures of charity, piety, temperance and soberness. These treasures a man takes with him beyond death, when he leaves this world.»

JAPANESE.

From letter of old Japanese Buddhist woman quoted by Reischauer in 'Studies in Japanese Buddhism' (1917):

«I am old and I am a woman, and it is not to be expected that a woman will know much of such subjects, but I will tell you what thoughts I have. I am weak and sinful, and have no hope in myself; my hope is all in Amida Buddha. I believe him to be the Supreme Being. Because of the wickedness of man, and because of human sorrow, Amida Buddha became incarnate and came to the earth to deliver man; and my hope and the world's hope is to be found only in his suffering love. He has entered humanity to save it; and he alone can save. He constantly watches over and helps all who trust in him. I am not in a hurry to die, but I am ready when the time comes; and I trust through the gracious love of Amida Buddha, I shall enter the future life which I believe to be a state of conscious existence, and where I shall be free from sorrow.»

From a letter written by Japanese Amidaist on death bed (ibid.):

«Should my sickness change for the worse, I shall never see you again in this life. But I shall, of a certainty, see once more, in the pure Land, all those who are partakers with me in the faith that I have in Amida.»

PHŒNICIAN.

Inscription of Eschmun 'Azar':

«Let there be no resting-place among the Rephâim for the man, even if he be of royal lineage, who ventures to open this chamber of repose, or remove the sarcophagus in which I am at rest.»

HEBREW.

Old Testament:

"For there is hope of a tree, if it be cut down, that it will sprout again, and that the tender branch thereof will not cease. Though the root thereof wax old in the earth, and the stock thereof die in the ground; yet through the scent of water it will bud, and put forth boughs like a plant. But man dieth, and is laid low: Yea, man giveth up the ghost, and where is he?"— Job xiv, 7–10.

"If a man die, shall he live again? All the days of my warfare would I wait, till my release should come. Thou wouldest call, and I would answer thee: thou wouldest have a desire to the work of thy hands.—Job. xiv, 13–15.

"But I know that my Avenger liveth, and that at the last He will appear above (my) grave: and after my skin hath been thus destroyed, with out my body shall I see God: and whom I shall see for myself, and mine desire to the work of thy hands.»— Job. xiv, 25–27.

"For thou dost not commit me to Sheol,
Nor sufferest thy faithful ones to see the pit.
Thou teachest me the pathway of life;
In thy presence is fulness of joys,
Fair gifts in thy right hand forever."

Psalm xvi, 10–11 (transl. by H. H. Furness).

"Like sheep they sink into Sheol
Death rules them, terrors affright them;
They go down straight into the grave
Sheol is their mansion forever."

Psalm xlix, 14–15 (transl. by Dr. Cheyne).

"And many of them that sleep in the land of dust shall awake, some to everlasting life, and some to shame and everlasting contempt."—Daniel xii, 2.

«For God created man to be immortal, and made him to be an image of his own eternity. . . . The souls of the righteous are in the hand of God and there shall no torment touch them. In the sight of the unwise they seemed to die: and their departure is taken for misery, and their going from us to be utter destruction: but they are in peace. For though they be punished in the sight of men, yet is their hope full of immortality. And having been a little chastised, they shall be greatly rewarded: for God proved them, and found them worthy for himself. As gold in the furnace hath he tried them, and received them as a burnt offering."—Wisdom of Solomon ii, 23 — iii, 1–6.

2 Baruch li, 7–10, 12 (quoted from R. H. Charles in his Eschatology):

"Those who have been saved by their works, and to whom the law has been now a hope, and understanding and expectation, and wisdom a confidence, to them wonders will appear in their time. For they will behold the world which is now invisible to them, and they will behold the time which is now hidden from them. And again, time will not age them. For in the heights of that world shall they dwell, and they shall be made like unto the angels, and be made equal to the stars, and they shall be changed into every form they desire, from beauty into loveliness, and from light into the splendor of glory. . . . Moreover there will then be excellency in the righteous surpassing that in the angels."

Book of Enoch xxii (quoted from R. H. Charles):

«And thence I went to another place, and Uriel showed me in the West another great and high mountain of hard rock. And there were four hollow places in it, deep and very smooth: three of them were dark and one bright, and there was a fountain of water in its midst. And I said: How smooth are these hollow places, and deep and dark to view. Then Raphael answered one of the holy angels who was with me, and said unto me: These hollow places have been created for this very purpose, that the spirits of the souls of the dead should assemble therein, yea that all the souls of the children of men should assemble here. And these places have been made to receive them till the day of their judgment and till their appointed period, till the great judgment (comes) upon them. I saw the spirit of a dead man making suit, and his voice went forth to heaven and made suit. And I asked Raphael, the angel who was with me, and I said unto him: This spirit which maketh suit, whose is it, whose voice goeth forth and maketh suit to heaven? And he answered me saying: This is the spirit which went forth from Abel whom his brother Cain slew, and he makes his suit against him till his seed is destroyed from the face of the earth, and his seed is annihilated from amongst the seed of men. Then I asked regarding all the hollow places, why is one separated from the other? And he answered me saying: These three have been made that the spirits of the dead might be separated. And this division has been made for the spirits of the righteous, in which there is the bright spring of water. And this has been made for sinners when they die and are buried in the earth and judgment has been executed upon them in their lifetime. Here their spirits will be set apart in this great pain, till the great day of judgment, scourgings and torments of the accursed forever, so that (there may be) retribution for their spirits. There shall He bind them forever. And this division has been made for the spirits of those who make their suit, who make disclosures concerning their destruction, when they were slain in the days of the sinners. And this has been made for the spirits of men who shall not be righteous but sinners, who are godless, and they of the lawless shall be companions: but their spirits shall not be punished on the day of judgment, nor shall they be raised from thence.»

GREECE.

In Homeric times the destiny awaiting man after death is one of totally unrelieved gloom. One passage in the 'Odyssey' gives a glimpse of something different in store for Menelaus:

" To thee it shall not come
In the horse-kind land of Argos to meet thy death and doom.
But unto the fields Elysian and the wide world's utmost end,
Where dwells tawny Rhadamanthus, the Deathless thee shall send,
Wherein are the softest life-days that men may ever gain;
No snow and no ill weather, nor any drift of rain;
But Ocean ever wafteth the wind of the shrilly west,
On menfolk ever breathing, to give them night and rest."

From early Orphic poems:

«They who are pious in their life beneath the rays of the sun enjoy a gentler lot when they have died, in the beautiful meadow around deep-flowing Acheron.»

«I have paid the penalty for deeds unjust and now I am come as a suppliant unto noble Persephone, beseeching her to be gracious, and to send me into the abodes of the pious.»

Pythagoras (589 B.C.):

«When thou shalt have laid aside thy body, thou shalt rise, freed from mortality, and become a god of the kindly skies.»

Heraclitus 500 (B.C.):

«My body must descend to the place ordained, but my soul will not descend: being a thing immortal, it will ascend on high, where it will enter a heavenly abode.»

From the second Olympian-Pindar:

«The guilty souls of the dead straightway pay the penalty here on earth; and the sins committed in this kingdom of Zeus are judged by One beneath the ground, hateful Necessity enforcing the doom he speaks. But ever through nights and ever through days the same, the good receive an unlaborious life beneath the sunshine. They vex not with might of hand the earth or the waters of the sea for food that satisfieth not, but among the honored Gods, such as had pleasure in keeping of oaths enjoy a tearless life; but the others have pain too fearful to behold. Howbeit they who thrice on either side of death have stood fast and wholly refrained their souls from deeds unjust, journey on the road to Zeus to the tower of Cronus, where the ocean-breezes blow around the island of the blest, and flowers gleam bright with gold, some on trees of glory on the land, while others the water feeds; with wreathes whereof they entwine their arms and crown their heads.»

Æschylus:

" There thou shalt see in durance drear,
'Gainst god or guest or parents dear,
Like thee who sinned, receiving their due meed.
For Hades, ruler of the nether sphere,
Exactest auditor of human kind,
Graved on the tablet of his mind
Doth every trespass read."

Sophocles:

" But a good hope I cherish, that, come there,
My father's love will greet me, yea and thine,
My mother — and thy welcome, brother dear."

Socrates in the 'Apology':

«If death is, like sleep, even then I say that to die is gain: for eternity then is only a single night. But if death is the journey to another place, and there, as men say, all the dead are, what good, O my friends and judges can be greater than this? If, indeed, when the pilgrim arrives in the world below, he is delivered from the professors of justice in this world, and finds the true judges who are said to give judgment there, Minos and Rhadamanthus and Aeacus and Triptolemus, and other half gods who were righteous in their own life, that pilgrimage will be worth making. What would not a man give if he might converse with Orpheus and Musæus and Hesiod and Homer? Nay, if this be true, let me die again and again. Above all I shall be able to continue my search into true and false knowledge; as in this world, so also in that; and I shall find out who is wise, and who pretends to be wise, and is not. . . . Besides being happier in that world than in this, they will be immortal, if what is said is true.»

«Is it not strange, my friends, that, after all I have said to convince you I am going to the society of the happy, you still think this body to be Socrates? Bury my lifeless body where you please; but do not mourn over it, as if that were Socrates. . . . It would be wrong for me not to be grieved to die, if I did not think I should go to dwell with men who have departed from this life, and are better than any who are here. And be assured I hope to go and dwell among good men. I entertain a good hope that something awaits those who die, and that it will be better for the good than for the evil, as has been said long since.»

Xenophon introduces dying Cyrus to his children:

«By the paternal gods, my sons, respect one another, if you care to please me. For you surely do not imagine that you know clearly that I shall be nothing, when I have finished with my human life. For even now you never saw my soul, but you knew its existence from what it did. And have you not seen, what terrors the souls of those who have suffered injustice bring upon the criminals; what avenging spirits they send to the evil doers? And do you believe that the honors paid to the dead would continue, if their souls had no longer any power? I, indeed, O sons, have never believed that the soul while it is in a mortal body lives, and is dead when it is free from it: for I see that even these mortal bodies live only so long as the soul is in them. Nor can I believe that the soul will be without reason, after it has been separated from this unreasoning body; but when the mind has been separated, unmixed and pure from the body, then it is likely that it will be most rational. . . . Consider also that nothing is nearer to human death than sleep, and that the soul of man seems then most divine, and sees then something of the future, because it is then most free. If then these things are as I believe, and the soul leaves the body, do what I ask from reverence for my soul. But if it is not so, and the soul remains in the body and dies, even then do not do or think anything impious or unholy for fear of the eternal, the omniscient, the omnipotent gods, who hold together this order of all things, flawless, unfading, unfailing and inconceivable by its greatness and by its beauty.»

Euripides:

«Let now the dead bodies be covered by the earth, and each go away whence it came into the body; the breath to the æther, the body to the earth.»

Plato ('Phædo'):

«Those who have been pre-eminent for holiness of life are released from this earthly prison, and go to their pure home which is above, and dwell in the purer earth; and those who have duly purified themselves with philosophy, live henceforth altogether without the body, in mansions fairer far than these, which may not be described, and of which the time would fail me to tell.»

«The soul of each of us is an immortal Spirit and goes to other immortals to give an account of its actions. Those who have lived a holy life, when they are freed from this earth and set at large, will arrive at a pure abode above, and live through all future time. They will arrive at habitations more beautiful than it is easy to describe.»

Popular verses on Harmodius and Aristogiton:

Dearest Harmodius, thou art surely not dead,
Thou dwellest, they say, in the isles of the blest,
Where the swift-footed Achilles,
Where the son of Tydeus, the brave Diomedes, dwells.

Greek inscription on a daughter:

«Mother, leave thy grief, remembering the soul which Zeus has rendered immortal and undecaying to me for all time, and has now carried into the starry sky.»

Epitaph (trans. by Hon. Lionel A. Tollemache):

" Dying, thou art not dead!—thou art gone to a happier country,
And in the aisles of the blest thou rejoicest in weal and abundance,
There, Proté, is thy home in the peace of Elysian meadows,
Meadows with Asphodel strewn, and peace unblighted with sorrow.
Winter molests thee no longer, nor heat nor disease; and thou shalt not
Hunger or thirst any more; but, unholpen of man and unheedful,
Spotless and fearless of sin, thou exultest in view of Olympus;
Yea, and thy gods are thy light, and their glory is ever upon thee."

ROMAN.

Cato (quoted by Cicero, 200 B.C.):

«O glorious day, when I shall remove from this confused crowd to join the divine assembly of souls! For I shall go not only to meet great men, but also my own son. His spirit, looking back upon me, departed to that place whither he knew that I should soon come; and he has never deserted me. If I have borne his loss with courage, it is because I consoled myself with the thought that our separation would not be for long.»

Seneca:

«This life is only a prelude to eternity, where we are to expect another state of things. We have no prospect of Heaven here, but at a distance: let us, therefore, expect our last hour with courage. The last I say to our bodies, not to our minds. The day which we fear as our last is but the birthday of eternity. . . . This we presume, either we shall pass out of this life into a better one, where we shall live in diviner mansions, or else return to our first principles, free from any sense of inconvenience. . . . It is the care of a wise and good man to look to his manners and actions; and rather how well he lives than how long. To die sooner or later is not the business, but to die well or ill; for death brings us to immortality.»

CHRISTIAN ERA.

Paul (Cor. xv, trans. by Dr. James Moffatt):

«Someone will ask, 'How do the dead rise? What kind of body have they when they come?' Foolish man! What you sow never comes to life unless it dies. And what you sow is not the body that is to be; it is a mere grain of wheat, for example, or some other seed. God gives it a body as he pleases, gives each kind of seed a body of its own . . . There are heavenly bodies and also earthly bodies, but the splendor of the heavenly is one thing and the splendor of the earthly is another. There is a splendor of the sun and a splendor of the moon and a splendor of the stars — for one star differs from another star in splendor. So with the resurrection of the dead: what is sown is mortal, what rises is immortal; sown inglorious, it rises in glory; sown in weakness, it rises in power; sown an animate body, it rises a spiritual body. As there is an animate body, so there is a spiritual body. . . . I tell you this, my brothers, flesh and blood cannot inherit the Realm of God, nor can the perishing inherit the imperishable. Here is a secret truth for you: not all of us are to die, but all of us are to be changed — changed in a moment, in the twinkling of an eye, at the last trumpet-call. The trumpet will sound, the dead will rise imperishable, and we shall be changed. For this perishing body must be invested with the imperishable, and this mortal body invested with immortality; and when this mortal body has been invested with immortality, then the saying of Scripture will be realized. Death is swallowed up in victory.»

1 *Thessalonians, iv:*

«We would like you, brothers, to understand about those who are asleep in death. You must not grieve for them, like the rest of men who have no hope. Since we believe that Jesus died and rose again, then it follows that by means of Jesus God will bring with him those who have fallen asleep. For we tell you, as the Lord has told us, that we the living, who survive till the Lord comes, are by no means to take precedence of those who have fallen asleep. The Lord himself will descend from heaven with a loud summons when the archangel calls and the trumpet of God sounds; the dead in Christ will rise first; then we the living, who survive, will be caught up along with them in the clouds to meet the Lord in the air, and so we will be with the Lord forever.»

Revelations xx and xxi (trans. by Dr. Moffatt):

«Then I saw a great white throne, and One who was seated thereon; from his presence earth and sky fled, no more to be found. And I saw the dead, high and low, standing before the throne, and books were opened — also another book, the book of Life, was opened — and the dead were judged by what was written in these books, by what they had done . . . I heard a loud voice out of the throne, crying, 'Lo, God's dwelling place is with men, with men will he dwell; they will be his people and God himself will be with them; he will wipe every tear from their eyes, and death shall be no more — no more wailing or crying or pain.' »

NON-CHRISTIAN.

Marcus Aurelius Antoninus:

«If souls survive, how has ethereal space made room for them all from eternity? How has the earth found room for all the bodies buried in it? The solution of the latter problem will solve the former. The corpse turns to dust and makes space for another: so the spirit, let loose in the air, after a while dissolves, and is either renewed into another soul or absorbed into the universe.»

EARLY CHURCH.

The Clementina Homilies:

«For there is every necessity, that he who says that God who is by His nature righteous, should believe also that the souls of men are immortal; for where would be His justice, when some having lived piously, have been evil treated, and sometimes violently cut off, while others who have been impious, and have indulged in luxurious living, have died the common death of men? Since therefore, without all contradiction, God who is good is also just, He shall not otherwise be known to be just, unless the soul after the separation from the body be immortal, so that the wicked man, being in hell, as having here received of his good things, may there be punished for his sins; and the good man, who has been punished here for his sins, may there, as in the bosom of the righteous, be constituted as heir of good things. Since therefore God is righteous, it is fully evident to us that there is a judgment, and that souls are immortal.»

Gregory of Nyssa (394 A.D.):

«Is it a misfortune to pass from infancy to youth? Still less can it be a misfortune to go from this miserable life to that true life into which we are introduced by death. Our first changes are connected with the progressive development of life. The new life which death effects is only the passage to a more desirable perfection. To complain of the necessity of dying is to accuse Nature of not having condemned us to perpetual infancy.»

Council of Florence (1439 A.D.):

«The souls of those who, after baptism, did not incur any spot of sin, and of those who, after committing sin, were purified in life and by purgatorial pains, are immediately received in heaven, and there they clearly behold God, as He is one and triune with a perfection proportionate to each one's merits.»

POST REFORMATION.

Martin Luther:

«The Scriptures say that the holy and just go into the unseen world, and there enjoy the most pleasant peace and sweetest rest. As in this life they were wont to fall asleep in the guard and keeping of God and of the dear angels, without fear of harm, though the devils might prowl about them — so, after this life, they repose in the hand of God. When my soul departs, I know that highest kings and princes are appointed to attend me; namely, the dear angels themselves who will receive me and guard me on the way.»

Heidelberg Catechism (A.D. 1563):

«Not only my soul after this life shall be immediately taken up to Christ, its head, but also this body, raised by the power of Christ, shall be again united with my soul and made like unto the glorious body of Christ.»

Westminster Confession (xxxiii, 1):

«The bodies of men, after death, return to dust, and see corruption; but their souls (which neither die nor sleep), having an immortal substance, immediately return to God who gave them. The souls of the righteous, being then made perfect in holiness, are received into the highest heavens, where they behold the face of God in light and glory, waiting for the full redemption of their bodies: and the souls of the wicked are cast into hell, where they remain in torments and utter darkness, reserved to the judgment of the great day. Besides these two places for souls separated from their bodies, the Scripture acknowledgeth none.»

Episcopal Prayer Book:

«Almighty God, with whom do live the spirits of those who depart hence in the Lord, and with whom the souls of the faithful, after they are delivered from the burden of the flesh, are in joy and felicity.»

John Wesley ('Letters'):

«What is the essential part of heaven? Undoubtedly it is to see God, to know God, to love God. We shall then know both his nature, and his works of creation and providence and of redemption. Even in paradise, in the intermediate state between death and the resurrection, we shall learn more concerning these in an hour, than we could in an age, during our stay in the body. We cannot tell indeed how we shall then exist, or what kind of organs we shall have; the soul will not be encumbered with flesh and blood; but probably it will have some sort of ethereal vehicle, even before God clothes us 'with our noble house of empyrean light.'»

Catholic Encyclopædia:

«The blessed dead (after the resurrection with glorified bodies) enjoy, in the company of Christ and the angels, the immediate vision of God face to face, being supernaturally elevated by the light of glory so as to be capable of such a vision. There are infinite degrees of glory corresponding to degrees of merit, but all are unspeakably happy in the eternal possession of God.»

CLERGYMEN AND THEOLOGIANS: RECENT.

Charles H. Spurgeon:

«I believe that heaven is a fellowship of the saints, and that we shall know one another there. I have often thought I should love to see Isaiah. . . . I am sure I should want to find out good George Whitefield. . . . We shall have a choice company in heaven when we get there.»

Henry Ward Beecher:

«I believe I shall know my friends, and that they will know me in heaven; but there will be a great difference between the knowing in this life and the knowing in that. I know that we shall be as angels of God; I know we shall be as the sons of God.»

Charles Kingsley:

«'Brother,' said the abbot, 'make ready for me the divine elements, that I may consecrate them.' And he asking the reason therefor, the saint replied, 'That I may partake thereof with all my brethren before I depart hence. For know assuredly that within the seventh day I shall migrate to the celestial mansions. For this night stood by me in a dream those two women whom I love, and for whom I pray, the one clothed in a white, the other in a ruby-colored garment, and holding each other by the hand, who said to me that life after death is not such a one as you fancy: come, therefore, and behold what it is like.'»

Robert Collyer:

«If the Higher Powers should say to me, 'We have nothing else for you here or hereafter,' I think I should answer: 'I make no claim. I would love to see those I have lost once more; but if it is not to be so, I am still debtor for the untold blessings of my many years.'»

Cardinal Newman:

«It would be presumption to attempt to determine the employments of that eternal life which good men are to pass to in God's presence, or to deny that that state which eye hath not seen, nor ear heard, nor mind conceived, may comprise an infinite variety of pursuits and occupations. Still so far we are distinctly told, that the future life will be spent in God's presence, in a sense which does not apply to our present life.»

James Martineau:

«Were it the will of the Creator to change his arrangements for mankind, and to determine that they should henceforth live in this world ten or a hundred times as long as they do at present, no one would feel that new souls would be required for the execution of the design. And in the mere conception of unlimited existence there is nothing more amazing than in that of unlimited non-existence; there is no more mystery in the mind living for ever in the future, than in its having been kept out of life through an eternity in the past. . . . It is far more incredible that from not having been, *we are*, than that from actual being, we shall *continue to be*.»

Phillips Brooks:

«If we could only know, somewhat as John must have known after his vision, the presence of God into which our friend enters on the other side, the higher standards, the larger fellowship with all his race and the new assurance of immortality in God; if we could know all this how all else would give way to something almost like a burst of triumph as the soul which we loved went forth to such enlargement, to such glorious consummation of life.»

C. C. Everett ('Immortality and Other Essays'):

«Death is a sleep and an awaking; and we must believe that the soul emerges from the darkness of this sleep such as it was when it entered into it. The spirit will stand forth beautiful or deformed, pure or defiled, strong or weak, complete or imperfect, healthful or diseased, according to its nature while it was living, half concealed, in the tabernacle of flesh. . . . Death we believe leaves the spirit free to follow its own gravitation. He that struggles after the right and good . . . that spirit shall mount up into the realms of blessedness and peace; while those whose love has been downwards, and not up, shall fall . . . .»

Mgr. Vaughan (‹*Man or Ape*›):

«As to the past we are creatures of yesterday. As to the future, we are everlasting. . . . We are children of eternity, not of time. . . . It is in the future, endless existence that, as Christian faith assures us, our mental capacities will receive their full development, and all our aspirations will be completely gratified. The infinite, wise and beneficent Creator, who has filled our hearts with most ardent yearnings after an eternal life of light, happiness and love, has made ample provision for their realization.»

Borden P. Bowne (*in North American Review*, 1910):

«We have the sure conviction that moral and spiritual interests are the higher things in life, and we have also the clear conviction that these interests find no adequate completion and fulfilment in the life that now is. . . . Our reason, our conscience, our spiritual aspirations, carry us beyond the actual and beyond all that is possible under terrestrial conditions. These are the things within us which bear witness to immortality. All thinking about the world presupposes it to be rational, and if life is to end with the earthly act, then the play is a farce, a hideous opera bouffe, and there is no reason in it.»

Prof. H. A. Youtz (*in Biblical World*, 1912):

«The Christian doctrine of a future life has for its core and center the affirmation of the permanence of the spiritual order. . . . The spiritual universe can be trusted and all spiritual achievement is secure. . . . Goodness and love and courage and the spirit of service — we cannot believe that these can perish in a spiritual world. . . . They will survive in any spiritual world that is continuous with the life we know. And since character and love are not abstract ideals but concrete facts — expressions of personality — their continuance point to the persistence of personal identity.»

NON-CHURCHMEN.

Thomas Paine:

«I trouble not myself about the manner of future existence. I content myself with believing, even to positive conviction, that the Power which gave me existence is able to continue it in any form and manner he pleases, either with or without this body; and it appears more probable to me that I shall continue to exist hereafter, than that I should have existence as I now have, before that existence began.» . . . «I hope for happiness beyond this life.»

Robert G. Ingersoll:

«The larger and the nobler faith in all that is and is to be tells us that death, even at its worst, is only perfect rest. . . . There is this consolation: the dead do not suffer. If they live again, their lives will surely be as good as ours. We have no fear. We are all children of the same mother, and the same fate awaits us all. We, too, have our religion, and it is this — help for the living, hope for the dead.»

SCIENTISTS, POETS, LITERATI.

Kant:

«After death the soul possesses self-consciousness, otherwise it would be the subject of spiritual death, which has already been disproved. With this self-consciousness necessarily remains personality and the consciousness of personal identity.»

Benjamin Franklin:

«Life is a state of embryo, a preparation for life. A man is not completely born until he has passed through death.»

Charles Darwin (‹*Life and Letters*›):

«Believing as I do that man in the distant future will be a far more perfect creature than he now is, it is an intolerable thought that he and all other sentient beings are doomed to complete annihilation after such long-continued slow progress.»

John Stuart Mill (‹*Essay on Theism*›):

«All the probabilities in the case of a future life are that such as we have been made or have made ourselves before the change, such we shall enter into the life hereafter; and that the fact of death will make no sudden break in our spiritual life. If there be a future life, it will be at least as good as the present, and will not be wanting in the best features of the present life, improvability by our own efforts.»

Thomas Carlyle:

«Man endures but for an hour, and is crushed before the moth. Yet in the being and in the working of a faithful man is there already (as all faith from the beginning, gives assurance) a something that pertains not to this wild death-element of Time, but that which triumphs over Time, and *is*, and will be, when Time shall be no more.»

Ralph Waldo Emerson:

«Of what import this vacant sky, these puffing elements, these insignificant lives, full of selfish loves, quarrels and ennui? Everything is prospective, and man is to live hereafter. . . . All the comfort I have found teaches me to confide that I shall not have less in times and places that I do not yet know. . . . All I have seen teaches me to trust the Creator for all I have not seen. Whatever it be which the great Providence prepares for us, it must be something large and generous, and in the great style of his works.»

George Eliot:

" This is life to come
Which martyred men have made more glorious
For us to strive to follow. May I reach
That purest heaven; be to other souls
The cup of strength in some great agony;
Enkindle generous ardor; feed pure love;
Beget the smiles that have no cruelty;
Be the sweet presence of a good diffused,
And in diffusion ever more intense."

John Fiske (‹*Through Nature to God*›):

«So far as our knowledge of Nature goes the whole momentum of it carries us onward to the conclusion that the Unseen World, as the objective term in a relation of fundamental importance that has co-existed with the whole career of mankind, has a real existence. . . . The lesson of evolution is that through all these weary ages the human soul has not been cherishing in religion a delusive phantom, but in spite of seemingly endless groping and stumbling it has been rising to the recognition of its essential kinship with the ever-living God.»

Mark Twain (*'A Biography,' by Albert Bigelow Paine*):

«I have never seen what to me seemed an atom of proof that there is a future life. And yet — I am strongly inclined to expect one.»

Richard Watson Gilder (*on the death of Alice Freeman Palmer*):

"When fell to-day the word that she had gone,
Not this my thought: Here a bright journey ends
Here rests a soul unresting; here, at last,
Here ends the earnest struggle, that generous life—
For all her life was giving. Rather this,
I said (after the first swift, sorrowing pang)
Radiant with love, and love's unending power
Hence, on a new quest, starts an eager spirit . . ."

Hugo Münsterberg (*'The Eternal Life,'* 1905):

«Who dares to speak the word 'uncompleted'? Are the influences of our will confined to those impulses which directly and with our knowledge act on the nearest circle of our neighbors? Will not our friend, who left us in the best energy of his manhood, influence you and me and so many others throughout our lives, and what we gained from his noble mind — will it not work through us further and further, and may it not thus complete much of that which seemed broken off and uncompleted?»

Sir Oliver J. Lodge:

«Nor is it so with intellect and consciousness and will, nor with memory and love and adoration, nor all the manifold activities which at present strangely interact with matter and appeal to our bodily senses and terrestrial knowledge; they are not nothing, nor shall they ever vanish into nothingness or cease to be. They did not arise with us: they never did spring into being; they are as eternal as the Godhead itself, and in the eternal Being they shall endure for ever.»

Edward Roland Sill:

"What can we bear beyond the unknown portal?
No gold, no gains
Of all our toiling: in the life immortal
No hoarded wealth remains,
Nor gilds, nor stains.

"Naked from out that far abyss behind us
We entered here:
No word came with our coming, to remind us
What wondrous world was near,
No hope, no fear.

"Into the silent, starless night before us,
Naked we glide:
No hand has mapped the constellations o'er us,
No comrade at our side,
No chart, no guide.

"Yet fearless toward that midnight, black and hollow,
Our footsteps fare:
The beckoning of a Father's hand we follow—
His love alone is there,
No curse, no care."

CHARLES GRAVES.

FUTURE LIFE IN MYTHOLOGY. See MYTHOLOGY; NATURE WORSHIP.

FUTURISM, the word applied in 1911 by five Italian painters to a new theory of art which they claimed their own works exemplified. They themselves characterized their art as «violently revolutionary,» and exhibited paintings at that time (in the «first exposition of futurist paintings in Paris») which added zest to their declaration that «all truths taught in schools and ateliers are abolished.» Their guiding principles were sought in individual intuition and they declined to lean for support upon the example of the Greeks and the old masters, their frankly expressed purpose being the establishment of wholly new laws which should rescue modern painting from incertitude. Thus, Futurism is a movement away from old ideals and toward new ones, differentiated somewhat in this respect (and more obviously in methods of expression) from the nearly synchronous cubism.

FYFFE, fīf, **Charles Alan,** English historian: b. Blackheath, Kent, England, December 1845; d. 19 Feb. 1892. He was graduated at Oxford in 1868; and called to the bar in 1876, but never practised. As correspondent of the *Daily News* during the Franco-Prussian War he is said to have sent to that journal the first account of the battle of Sedan that appeared in print. His historical works are distinguished by accuracy and a pleasing, perspicuous style. They include 'History of Greece' (1875), in a series of 'History Primers'; and the well-known 'History of Modern Europe' (1880, 1886, 1890), covering the period from 1792 to 1878.

FYLES, Franklin, American dramatic critic and author. In 1886 he became dramatic critic of the New York *Sun*. He wrote several successful plays, including the military dramas 'Cumberland '61' and 'The Girl I Left Behind Me' and some works in book form, among them 'The Theatre and Its People' (New York 1900), a popular account of the profession; 'A Ward of France'; 'Drusa Wayne,' etc.

FYNE LOCH, Scotland, an inlet of the sea extending northeast from Bute Sound in Argyll. It is abo t 44 miles in length and its width varies from three to eight miles; the average depth being from 50 to 70 fathoms. The rivers Fyne, Aray and Shira flow into it. Great quantities of herrings are caught in its waters, and it is a favorite summer resort for hundreds of city dwellers.

FYT, fīt, **or FEYDT, John,** Flemish painter: b. Antwerp, 1611; d. there, 1661. He studied under Van den Birch, and at 20 was received into the Guild of Saint Luke. He spent a long time in Italy, as the numerous works executed there by him abundantly attest. His subjects embrace almost all living animals and reveal a deep knowledge of form. He was associated with Jordaens, Willeborts, etc. Among the works which they executed together may be mentioned the 'Repose of Diana' (1650), in the Vienna Museum. He is represented in all the principal collections of the world; the Metropolitan Museum of New York has three fine specimens of dead game pieces. He also executed some gravures.

FYZABAD, fiz'ō-băd, British India, a division of Oudh, in the United Provinces. Its area is 12,000 square miles, with a population of 6,646,362. Agriculture is in a prosperous state; wheat, rice and other cereals being grown extensively. Other crops are cotton, tobacco and indigo. The capital is Fyzabad, near the river Gogra, 75 miles east of Lucknow. It is rich in ancient remains and is a holy city of the Hindus. It has sugar factories and trades in the agricultural products of the region. A British commissioner resides in Fyzabad. Pop. 54,600.

G

G seventh letter of the English alphabet and of other alphabets derived from the Latin. In very early Latin, G stood for the proper g-sound (g hard, as in go) and also for the k-sound of C, as in cup; afterward the k-sound was represented by K, while G continued to represent the sound of G hard; but K did not remain long in the Latin alphabet, being superseded by C (always hard and equivalent to K). Both in Greek and Latin the gamma (Γ. G) was always the hard guttural in whatever situation, and hence *geographia* was pronounced gheographia, *genus* ghenus, etc. The softening of g-hard to j when g precedes e, i or y, began to prevail in the 6th century of our era, and it persists in the modern languages derived from Latin and in our own. In languages having words derived independently by each from some common stock, for example, the Indo-European languages, the interchange of c-hard, g-hard, k, and the aspirate gutturals ch, gh, is very common; examples: Eng. kin, Lat. *genus*, Gr. *genos;* Gr. *chen*, Ger. *gans*, Eng. goose; Gr. *gnonai*, archaic Lat. *gnosco*, Ger. *kennen*, Eng. ken; Lat. *hesternus*, Gr. *chthes*, Ger. *gestern*, Eng. yester: the same equivalence of g and y is seen in Ger. *gelb*, Eng. yellow; Ger. *gähnen*, Eng. yawn; Ger. *garn*, Eng. yarn. In French words of Teutonic origin an original w is often represented by gu (equal to g-hard), thus Wilhelm becomes *Guillaume;* Ger. *weise*, Fr. *guise;* Teuton *werra*, Eng. war, Fr. *guerre*.

GAÁL, gäl, **József**, Hungarian writer: b. Nagy Károly, 1811; d. 1866. He was educated at the University of Pesth, and soon after entered the employment of the Hungarian Council of Lieutenancy. He took a conspicuous part in the troubles of the revolutionary year of 1848. He contributed much to periodicals, especially sketches of country life. His works include 'Szirmay Ilona' (1836); 'Peleskei Notarius' (1838); a four-act comedy; 'Szvatopiuk,' a tragedy; 'Pusztai Kaland'; Tengeri Kalandaz Alföldön'; Hortobágyi éjszaka.' In 1837 he became a member of the Hungarian Academy. An edition of his novels was issued by Badics (Budapest 1880–82).

GABBATHA, a word occurring only in John xix, 18. It occurs in connection with the judgment by Pilate where he sat on a place called the Pavement, but in Hebrew, Gabbatha. Josephus does not mention this word, nor can it be found in other writings outside of the New Testament. Various attempts at identification with well-known sites have been made but without success. The introduction of the word has also made a philological puzzle which has brought forth many guesses as to the origin and form of the word. It was a place undoubtedly outside the Prætorium. One conjecture is that it was a local name for the outer court of the temple.

GABBRO, găb'rō, a general name for a large group of evenly crystalline igneous rocks, composed, typically, of plagioclase and pyroxene, and having granitic texture. Gabbros show by analysis much the same composition as basalts; the silica ranging from 46 to 59 per cent. They may be regarded as plutonic equivalents of basalts, basaltic magmas which have cooled at great depths. Under the general term gabbro are included anorthosites, abundant in Canada and the Adirondacks, high in silica and composed almost wholly of crystalline labradorite; true gabbros; norites, composed of plagioclase and orthorhombic pyroxene. With decreasing pyroxene and increasing olivine gabbros grade into peridotitles. Gabbros are heavy, dark-colored, usually greenish, rocks. They occur in the Adirondacks, in the neighborhood of Baltimore, Md., and particularly in the highlands along the north shore of Lake Superior, from Duluth to the international boundary. The gabbro near Duluth has this composition: SiO_2 49.15; Al_2O_3 21.90; Fi_2O_3 6.60; FeO 4.54; CaO 8.22; MgO 3.03; Na_2O 3.83; K_2O 1.61. See BASALT.

GABELENTZ, gä'bę-lents, **Hans Conon von der**, German philologist: b. Altenburg, 1807; d. 1874. He received his education at the universities of Leipzig and Göttingen; secured employment from the government of Saxe-Altenburg and in 1848 became chief minister. He studied many foreign and little known languages. He published 'Elements de la grammaire mandchoue' (1833); 'Grundzüge der syrjänischen Grammatik' (1841); 'Ueber der Passivum' (1860), which has examples from over 200 languages. He also published an edition of Ulfilas' Bible with Latin translation and Gothic glossary and grammar, and wrote 'Ueber die melanesischen Sprachen' (2 vols., 1860; 1873). He aided in founding *Zeitschrift für die Kunde des Morgenlandes*.

GABELLE, a term originally applied to all imposts; came in time to designate in particular the impost or tax on salt. This tax, one of the most crushing under the old monarchy, is already mentioned in an edict of Louis IX in 1246. At first levied only temporarily after a time it was made a permanent tax. In 1340 salt was declared a state monopoly and every household was obliged to buy a certain amount. The price was strictly regulated but was not the same in all provinces. Some provinces were exempt from the tax, having paid a special price for such exemption; others paid one-fourth the regular tax. The monopoly was always unpopular and was the cause of much rioting and disaffection. It persisted, however, as late as 1790 when it was finally suppressed. Consult Gasquet, A., 'Précis des institutions politiques de l'ancienne France' (2 vols., Paris 1885).

GABELSBERGER, gä'bels-bĕr'gĕr, **Franz Xaver,** German pioneer in stenography: b. Munich, 1789; d. 1849. He was educated in his native city; secured the position of private secretary to the Ministry of the Interior there, and published texts and charts for schools. He finally became interested in stenography, gave public exhibitions of his system, and at length received the approval of the Academy of Sciences for his work in the new field. His system achieved a wide popularity in Germany and was adapted also to other European languages. A monument to Gabelsberger was erected at Munich in 1890. He published 'Anleitung zur deutschen Redezeichenkunst' (1834; Eng. trans. by Richter 1899); 'Neue Vervollkommnungen in der deutschen Redeschreibekunst' (1849); 'Stenographische Lesebibliothek' (1838).

GABES, gä bĕs, or **CABES,** Tunisia, capital and seaport of the province of Arad, at the head of the gulf of the same name, 70 miles southwest of Sfax. It is on the site of the Roman Tacape, has European and Arab quarters and a large trade in dates, skins, wool and oil. It is the seat of the provincial governor and has a garrison of French troops. Pop. 20,000.

GABII, gä'bē-ī, city of Latium in ancient Italy, 13 miles east of Rome. It occupies a prominent part in early Roman history; was captured by Tarquinius Superbus, and gradually fell into decay. Subsequently it was granted municipal rights and in the reign of Tiberius again prospered owing to its sulphur springs bringing numbers of Romans. Thereafter for about three centuries it enjoyed renewed prosperity, but again sank into decay, and little is heard of it beyond that it continued to be the seat of a bishop until the 9th century. There are many interesting ruins, especially those of a temple of Juno. Excavations have brought to light many works of art, now scattered in the museums of Europe. Statues and busts have been turned up in great numbers and include Agrippa, Tiberius, Hadrian, Germanicus, Caligula, Nero, Trajan, M. Aurelius, Geta and others. Consult Visconti, E. Q., 'Monumenti Gabini della Villa Pinciana' (Milan 1835).

GABINIUS, Aulus, Roman statesman: d. 48 or beginning of 47 B.C. When tribune of the people in 67 B.C., he brought forward the *lex Gabinia*, by which Pompey was granted the command of the war against the pirates, and absolute control over the Mediterranean and its coasts for 50 miles inland. Gabinius was prætor in 61 B.C., and provided public games on a scale of great splendor. In 58 he became consul and during his term helped Clodius to bring about the exile of Cicero. In 57 Gabinius went to Syria as proconsul; he reinstated Hyrcanus as high-priest at Jerusalem, suppressed various revolts and, at the request of Pompey, and without the consent of the Senate, went into Egypt and restored Ptolemy Auletes to his kingdom. While absent in Egypt, his province of Syria was overrun by robbers and freebooters, resulting in serious loss of revenue to the Equites, who farmed the taxes. On his return to Rome he was brought to trial on three charges, was acquitted of treason, but convicted of extortion and sent into exile. He was recalled by Cæsar in 49, and by him was sent to Illyricum. He defended himself bravely against Marcus Octavius, the Pompeian commander, but died of illness after a few months. Consult Stocchi, G., 'Aulo Gabinio e i suoi processi' (Torino 1892).

GABION, a cylindrical basket without bottom used for various purposes in military engineering. When placed in position it is filled with earth or sand and is usually woven from brush cut nearby. See FORTIFICATIONS.

GABLE, the triangular or quadrangular end of a house or other building, from the cornice or eaves to the top, and distinguished from a pediment by this, among other things, that it has no cornices, while a pediment has three. The word is also applied to the highly decorated canopy or screen which in Gothic church architecture rises over some doors or windows. The wall of a house which is surmounted by a gable is called the gable-end. In modern towns the gable-ends of houses are usually at right angles to the line of the street, but in the Middle Ages the reverse was usually the case, the gable ends being turned toward the street. Many old towns in France, Belgium and Germany are still to be seen with this peculiarity, and some even in Britain. In Scotland, a wall separating two houses, and common to both, is called a mutual gable, and according to Scotch law such a gable is the property of the builder, who can therefore prevent the owner of an adjoining property from using the support of his gable, unless he pays half the cost of erecting it.

GABLONZ, gä'blonts (Czech, *Jablonec*), Bohemia, town on the Neisse, 95 miles northeast of Prague. It contains a gymnasium and several trade and professional schools. It is the chief seat of the glass and imitation jewelry manufacture. It has also woolen and cotton factories, hardware, papier mâché and other paper goods factories. Pop. 29,600.

GABORIAU, gä-bō-rē-ō, **Emile,** French writer of detective stories: b. Saujon, Charente-Inférieure, France, 9 Nov. 1835; d. Paris, 28 Sept. 1873. His early years were a succession of vicissitudes; the army, the law, and even the Church, were in turn the objects of his inconstant attentions till at last when he had already contributed to some of the smaller Parisian papers, he leaped into fame at a single bound with his story 'L'Affaire Lerouge' (1866), in the feuilleton to *Le Pays*. It was quickly followed by 'Le Dossier 113' (1867); 'Le Crime d'Orcival' (1868); 'Monsieur Lecoq' (1869); 'Les Esclaves de Paris' (1869); 'La Vie Infernale' (1870); 'La Clique Dorée' (1871); 'La Corde au Cou' (1873); 'L'Argent des Autres' (1874); and 'La Dégringolade' (1876).

GABRIAC, gä-brē-äk, **Paul Joseph de Cadoine,** MARQUIS DE, French diplomatist: b. Heidelberg, Baden, 1 March 1792; d. Paris, 12 June 1865. He was consul-general in New York in 1812–14; appointed Minister to Stockholm in 1823; and Minister to Brazil in 1826. While in Brazil he induced all the other states in South America to adopt the French maritime law. He was created a peer in 1841, and made a life senator in 1853. His publications include 'The Question of Brazil' (1829); 'The Republics of South America Considered in Their Future' (1851); 'King Pedro I, Notes and Personal Recollections' (1854).

GABRIEL (Heb. "hero, or man, or champion of God"), among the post-exilic Jews, one of the seven archangels (q.v.). In the book of Daniel and in the third gospel he is the messenger and interpreter of God. The rabbins represented him as the angel of death to the Israelites, as Azrael was to the Mohammedans. According to the teaching of the Koran he is one of the four angels, of which the other three are Michael, Uriel and Raphael, most highly favored by God. The Gnostics held that Gabriel was one of the creators of the universe; and Paul warns the Colossians against errors of this kind (Col. ii, 18). They also held that Gabriel was one of the celestial law givers; and oratories were erected to him in Asia Minor, where he was worshipped as a god. One of the old conceptions of Gabriel was that he was the great culture hero who rid the earth of giants and evil spirits of all kinds; and in the book of Enoch the Creator is represented as commanding: "Go Gabriel, against the giants, the spurious ones, the sons of fornication, and destroy the sons of the watchers from among the sons of men." The old belief that Gabriel was the messenger of death is still preserved in the north of England in the popular superstition of "Gabriel's hounds," a spectral pack thought to foretell death by their howling at night. They are believed to be the souls of unbaptized children doomed to wander through the air until the day of Judgment. According to the rabbins Gabriel had distinctly the offices of an ancient culture god. He was the prince of fire; he presided over the ripening of fruit; he taught Joseph the 70 languages spoken at the dispersion of Babel; he helped Michael destroy the host of Sennacherib; he set fire to the temple at Jerusalem and he was the only one of the angels who understood Chaldee and Syriac. According to the Mohammedans he is the great judge destined to weigh men's actions on the last day; and the Koran calls him the Holy Spirit, The Spirit of Truth. He it was who gave the Koran, the book of knowledge, to Mohammed. His characteristics, as thus outlined, correspond to those of Thoth, the Egyptian culture god and judge of the dead, the giver of all knowledge and the special patron of learning. It is interesting to note that Gabriel's characteristics become strongly marked after the exile of the Jews to Egypt.

GABRIEL, The Congregation of the Brothers of, a religious order in the Roman Catholic Church, founded in 1705, by Grignon de Montfort, to educate the young and to look after orphans and deaf, dumb and blind. Abbé Deshayes established the order firmly in France in the 19th century. In this work he acted in concert with the Abbé de Lamennais. The latter subsequently left the institution and organized the Brothers of Christian Instruction; and the original "Congregation" in 1835 took its present name. In 1858 the Congregation had 73 establishments and over 400 members. On the suppression of the order in France in 1905 the headquarters were transferred from Saint-Laurent-sur-Sèvre (La Vendée) to Péruwelz, Belgium. In the following year 170 schools, 12 homes for deaf, dumb and blind, and others for orphans were conducted by the "Congregations." The order in Canada was introduced there in 1888, and has establishments in several places and also in Burlington, Vt. They have three colleges and close upon a score of elementary schools in America.

GABRIELS, Henry, American Roman Catholic prelate: b. Wannegem-Lede, Belgium, 6 Oct. 1838. He studied classics in the colleges of Audenarde and Saint Nicholas, and theology in the Seminary of Ghent, where he was ordained priest, 21 Sept. 1861. He continued his studies at the University of Louvain, from which institution he received the degree of S.T.L. in 1864 and the honorary degree of doctor of theology in 1882. When the Theological Seminary of Troy, N. Y., was founded, Dr. Gabriels was one of the four priests sent from Belgium to manage it. He was diocesan examiner for New York and Albany, vicar-general of Ogdensburg and Burlington and one of the secretaries of the Third Plenary Council of Baltimore, the decrees of which he assisted in formulating. For 20 years Dr. Gabriels was rector of Troy Seminary and for nearly 30 years its professor of dogmatic theology, Church history and Hebrew. On 21 Dec. 1891, Pope Leo XIII appointed him bishop of Ogdensburg and he was consecrated at Albany, N. Y., 5 May 1892.

GABRIEL'S INSURRECTION, an attempted slave rising near Richmond, Va., in 1800, headed by a slave named Gabriel, called also "General Gabriel" and "Jack Bowler." He belonged to a planter named Thomas Prosser, and was about 24; tall, powerful and noted as a fighter. He drew about a thousand negroes into a plot to attack Richmond by night, massacre the inhabitants, seize the arsenal and arming themselves effectively, rouse a general insurrection. One August night he collected his forces, armed them with scythe blades and marched toward the city. Meanwhile a negro had disclosed the plot; James Monroe, then governor, had ordered out the militia; a creek in Gabriel's way proved to be unfordable, and hearing that the citizens were in arms, the whole force dispersed to the swamps and woods. They were hunted out, and many hanged, including Gabriel.

GABRILOVITCH, Ossip, Russian pianist: b. Saint Petersburg, 7 Feb. 1878. He was educated at the Saint Petersburg Conservatory of Music, was a pupil of Tolstoff and Rubinstein. In 1894 he won the Rubinstein prize and later studied with Leschetizky and Navratil, Vienna. In 1896 he made his début in Berlin, and subsequently went on a concert tour of Russia, England, Sweden, Austria and America. He has made many successful tours in the United States since his first appearance there in 1900. He married Clara Clemens, daughter of Mark Twain, in 1909.

GAD, the Tribe. Gad, the son of the Patriarch, was descended from Jacob and the slave-girl Zilpah. The position of the tribe on the march to the Promised Land was on the south side of the tabernacle. The leader of the tribe on the march from Sinai was Eliasaph, son of Deul or Reul. On the division of the land of

Canaan, their portion was east of the central part of the river Jordan. They numbered 40,500 which was 5,150 less than when they left Egypt. They bravely took their share in the subjugation of the country and thus complied with the conditions made by Moses. They were a tribe of shepherds and cattle men and asked for the allotment which they received because of its suitability as a grazing country. They were also a fierce and warlike people. When the kingdom was divided, Gad adhered to the northern section. Gad was taken into captivity by Tiglath-Pileser. Her cities in the time of Jeremiah were occupied by the Ammonites, and the tribe never returned to its homeland. At one time Gilead and Gad were synonymous terms.

GADARA, Palestine. It is not mentioned in the Bible, but the country of the Gadarenes is, which probably amounts to the same thing. It was the scene of the casting out of the demons by Jesus and their entry into the swine. Gadara was a Greek city of importance, east of the Jordan, mentioned by Josephus, Polybius, Epiphanius, Pliny and Eusebius. It was a strongly fortified city. According to the Nishna it was fortified by Joshua. The first mention it receives in history was its capture along with other cities by Antiochus the Great in 218 B.C. About 20 years later it capitulated to Alexander Jannæus after a siege of 10 months. It was in the hands of the Jews for some time but was destroyed during the civil wars. Demetrius, a Gadarene, was a freeman of Pompey and to please him the city was rebuilt and the citizens given complete freedom under Gabinius, the proconsul. Judea was divided into five districts, Gadara was made the executive centre of one of them (B.C. 57–55). Under the reign of Herod the Great it was under his dominion, having been presented to him by Augustus Cæsar. After Herod's death it again became part of the province of Syria. When the Jews revolted in 70 A.D. the city was captured by Vespasian. Later its importance continued and it was the seat of an episcopal see. Its bishops were members of the councils of Nice and Ephesus. It is also mentioned in the Talmud. After the Mohammedan conquest the city went to ruin and has been deserted for centuries. Its ruins have been identified at a site now called Umm Keis. The ruins prove the city to have been very rich and beautiful. They occupy a space of about two miles in circumference. Near the city were some baths known as the Thermiæ Heliæ and said to be inferior only to the baths of Baiæ. Epiphanius states that a yearly festival was held at the baths. He also intimates that some of the inhabitants dwelt in the caverns later used for tombs. For some years the Christians of Nazareth held an annual festival at Umm Keis, but Bedouin raids have put a stop to their observance.

GADDI, the name of four painters of the early Florentine period. (1) GADDO GADDI, b. about 1260; d. 1333. He began his career as both painter and mosaicist. The mosaic near the portal of the cathedral at Florence is attributed to him, as also those in the portico of the basilica of S. Maria Maggiore. Other mosaics by him were in old Saint Peter's, Rome, and in S. Maria Novella, Florence, but these have long since perished. No picture from his hand is now extant. (2) His son, TADDEO GADDI, b. about 1300; d. 1366, is said to have been Giotto's assistant for almost a quarter of a century. His works include 'The Virgin and Child with the Phophets,' in the Giugni chapel, at S. Croce, Florence; 'Virgin and Child,' in the Berlin Museum; other subjects in the Naples Museum; 'Scenes from Life of St. Lorenzo' in the Brooklyn Museum; frescoes in S. Maria Novella, Florence, and mosaics in the Florentine baptistry. He planned the Ponte Vecchio, and was architect of the Companile after the death of Giotto. (3) AGNOLO GADDI, son of Taddeo, b. about 1350; d. October 1396. His works include 'Resurrection of Lazarus' in S. Jacobo tra' Fossi, Florence; frescoes in the Pieve di Prato and in Santa Croce. (4) GIOVANNI GADDI, brother of the preceding, d. 1383. He was also a painter and gave promise of genius which was cut short by his early death. Consult Crowe and Cavalcaselle, 'History of Painting in Italy' (Vol. I, London 1903), and Vasari, 'Lives of the Most Eminent Painters, Sculptors and Architects' (10 vols., New York 1912).

GADE, Niels Wilhelm, nēls vĭl'hĕlm gä'dė, Danish composer: b. Copenhagen, 22 Feb. 1817; d. there, 21 Dec. 1890. In 1841, by his overture entitled 'Echoes of Ossian,' he gained in Copenhagen the prize of the Musical Union. He was supported during his studies abroad by a royal stipend, and in 1844 was appointed to succeed Mendelssohn in the direction of the Gewandhaus concerts at Leipzig. In 1850 he was appointed musical director to the king of Denmark, and in 1876 received a life pension. His works, which are Mendelssohnian in character, include seven symphonies, several overtures, sonatas, quintets, etc.; a lyrical drama, 'Comala'; a religious cantata, 'The Crusaders'; an opera, 'The Nibelungen,' etc.

GADFLY. See HORSEFLY.

GADIDÆ, găd'ĭ-dē, a family of fishes, the cods, sub-order *anacanthini* (spineless fishes), with ventral fins attached to the breast or throat. The body is rather long, a little compressed and covered with small, soft scales; the teeth are in several rows; the gill covers, which are large, have seven rays; the median fins are generally very large, and divided into several portions. They are voracious fishes. They are found chiefly in the depths of the colder seas, and are largely used for the food of man. Fossil remains are rare, but scattered bones have been found as far back as the Eocene. See COD; HADDOCK; LING; etc.

GADOLIN, gä'dō-lēn, **John,** Finnish chemist: b. Abo, Finland, 5 June 1760; d. Wirmo, Finland, 15 Aug. 1852. He studied chemistry under Bergman and in 1797 was appointed professor of chemistry in Abo — an office which he held till 1822. He devoted himself to investigations on mineral and metallurgic subjects. But the research for which he is specially remembered was upon a black mineral found in the porcelain feldspar quarry at Ytterby, near Stockholm, by Arhenius, of which an account had been published in 1788. In 1794 he read a paper to the Academy of Sciences, and showed that it contained a new kind of earth. This discovery was subsequently confirmed by Ekeberg, who called the earth yttria, and the mineral gadolinite, after its first investigator. The yttria was afterward shown to be a mixture of several earths.

GADOW, gä'dow, **Hans Friedrich**, German-English naturalist: b. Pomerania, 8 March 1855. He was educated at Frankfort-on-Oder, and at the universities of Berlin, Jena and Heidelberg. In 1880–82 he was employed in the natural history department of the British Museum and in 1884 was made Strickland curator and lecturer on zoology at the University of Cambridge. His publications are 'In Northern Spain' (1897); 'A Classification of Vertebrata' (1898); 'The Last Link by E. Haeckel' (1898); 'Through Southern Mexico' (1908); 'Aves' (in Brown's 'Animal Kingdom'); 'Amphibia and Reptiles' (in Cambridge 'Natural History'); 'The Wanderings of Animals,' and papers in Royal Society transactions and other scientific periodicals.

GADSDEN, Christopher, American patriot: b. Charleston, S. C., 1724; d. there, 28 Aug. 1805. He was educated in England; returned to the United States in 1741 and later engaged in business in Philadelphia; was a member of the first Colonial Congress which convened in New York in October 1765, and was also a member of the first Continental Congress which assembled in Philadelphia in 1774. He joined the American army as colonel at the beginning of the Revolution, and was promoted brigadier-general in 1776.

GADSDEN, James, American diplomatist: b. Charleston, S. C., 15 May 1788; d. there, 25 Dec. 1858. He was graduated at Yale College in 1806; served with distinction in the War of 1812. He was aide-de-camp to General Jackson in 1818 and took part in the campaign against the Seminole Indians. He became military inspector of the South Division in 1820 and had the principal part in the removal of the Seminoles to southern Florida in 1820. He was appointed Minister to Mexico in 1853, and on 30 December of that year negotiated the Gadsden Purchase (q.v.), which fixed a new boundary between Mexico and the United States.

GADSDEN, Ala., city and county-seat of Etowah County, on the Chattanooga Southern, the Louisville and Nashville, the Southern and the Nashville, Chattanooga and Saint Louis railroads, 56 miles northeast of Birmingham. It is dominated by Lookout Mountain, on the north bank of the Coosa River which gives its name to the rich coal and iron mines in the vicinity. There are several steam-mills which manufacture considerable quantities of yellow-pine lumber. Further industries include steel and wire-nail mills, cotton mills, a pipe works, a car and foundry establishment, a pressed-brick plant, a cotton-seed-oil mill and ginnery, and manufactories of wagons, doors, blinds, handles, etc. There are 15 churches, a national and a State bank, and two newspapers, a daily and a semi-weekly. Pop. 14,642.

GADSDEN PURCHASE, The, a tract of territory, embracing 45,535 square miles, which was purchased by the United States from Mexico in 1854. This region, which is bounded on the north by the Gila River, on the east by the Rio Grande, and on the west by the Colorado, was acquired by treaty and the payment of $10,000,000, and is now included in the southern part of the Territories of Arizona and New Mexico. It is called the Gadsden Purchase after James Gadsden (q.v.), United States Minister to Mexico in 1853, by whom, in December of that year, the treaty of sale was negotiated with Santa Anna (q.v.). Issues growing out of the execution of the Treaty of Guadalupe-Hidalgo (q.v.) made this negotiation a matter of great importance, as well as a business of much difficulty. Disputes had arisen concerning the boundary line between Chihuahua and New Mexico, involving the possession of the Mesilla Valley, of which, though claimed by the United States, the Mexicans took armed possession. The 11th article of the treaty, imposing upon the United States the obligation to restrain the Indian marauders on the Mexican frontier, had been neglected, and the reclamations in consequence amounted to between $15,000,000 and $30,000,000. By Gadsden's treaty that article was abrogated and a new boundary was agreed upon, while Mexico also agreed to forego all claims against the United States for damages on account of Indian depredations between the years 1848–53. The settlement of the boundary dispute was considered in this country to be of greater moment than the requisition of the land, which was thought to be of little or no value for cultivation; and it was in the minds of enterprising Americans that through this region the Southern Pacific Railroad, already projected, might find an advantageous route, as in fact it did. In Mexico the transaction was vigorously opposed, and on account of his part in the sale Santa Anna, in 1855, was banished from his country as a traitor. On the part of the United States, the Senate made some modifications in the original treaty and then ratified it. On 30 June 1854 it was finally proclaimed. Consult Haswell, 'Treaties and Conventions' (Washington 1889).

GADSDEN TREATY. See ANNEXATION; BOUNDARIES OF THE UNITED STATES; GADSDEN PURCHASE.

GADSHILL, England, a hill near Rochester, on the road from London to Gravesend. It is commemorated in Shakespeare's play, 'Henry IV,' as the place where Falstaff had his encounter with the robbers, and an inn at the place is called Falstaff's Inn. It is interesting in modern times for Gadshill Place, opposite the hill, which was long the residence of Charles Dickens and was the home in which he died.

GADSKI, gädz'kē, **Johanna**, German opera singer: b. Anclam, Prussia, 1871. She received her musical training in Stettin, made her début in opera in Berlin in 1889, and six years afterward, as one of the Damrosch German company in New York, appeared as Brünhilde and in numerous other Wagnerian parts. She made a concert tour in America in 1898–99; married an Austrian, T. Tauscher, in 1892; has excelled in the interpretation of heroines of Wagner's operas.

GADWALL, or **GRAY DUCK**, a migratory wild duck (*Chaulelasmus streperus*) found on all the four continents. It is less in size than the mallard and mainly black, brown and white in color. It frequents western marshes in small flocks, but is rare east of the Alleghany Mountains. As a table delicacy it is highly prized.

GÆA, gē'ȧ, or **GE,** gē, in Greek mythology, the goddess of the earth. She appears in Hesiod as the first-born of Chaos and the mother of Uranus and Pontus. She also bore the Titans, Cyclops, Erinyes, Giants, etc. As the vapors which were supposed to produce divine inspiration rose from the earth, Gæa came to be regarded as an oracular divinity; the oracles at Delphi and Olympia were believed to have once belonged to her. Her worship extended over all Greece, black female lambs being offered on her altars. She was also the goddess of marriage, and again of death and the lower world. At Rome Gæa was worshipped as Tellus.

GAEDERTZ, gĕd'ĕrts, **Karl Theodor,** German poet: b. Lübeck, 8 Jan. 1855; d. 1911. In 1880 he obtained a post in the Royal Library of Berlin and he was appointed chief librarian at Greifswald in 1903. His poems in Low German include 'Julklapp' (3d ed., 1899) and 'Eine Komödie' (2d ed., 1881). He also wrote valuable monographs on German poets and on the history of German drama, his chief works in this field being 'Goethe's Minchen' (2d ed., 1888); 'Aus Fritz Reuters jungen und alten Tagen' (3d ed., 1899); 'Emanuel Geibel: Ein deutsches Dichterleben' (1897); 'Bismarck und Reuter' (1898); 'Bei Goethe zu Gaste' (1900), and 'Im Reiche Reuters' (1905).

GAEL, gāl, the name of a branch of the Celts inhabiting the Highlands of Scotland, Ireland and the Isle of Man. Gadhel, or Gael, is the only name by which those who speak the Gaelic language are known to themselves. By way of distinction the Highlanders of Scotland call themselves Gael Albinnich (Gaels of Albin) and the Celtic population of Ireland call themselves Gael Erinnich (Gaels of Erin). See CELTS.

GAELIC LANGUAGE. See CELTIC LANGUAGE.

GAELIC LEAGUE, The. From the passing of the Statute of Kilkenny in 1367, the policy of the English governors of Ireland was to discourage the use of the Irish language, and even to root it out entirely; and from time to time other laws, with various pains and penalties attached in case of non-observance, were enacted with the same end in view. It was a vain attempt. The people clung with singular tenacity to their own language, and many of the English settlers adopted it, so that in the early part of the 19th century, out of a total population of 7,000,000, at least 4,000,000 spoke Irish as their native tongue. A more insidious method than penal legislation was then adopted. Under the primary school system, conducted by the Board of National Education established in 1831, the Irish language was both banished from the curriculum and forbidden as a medium of instruction, the motive of course being to establish, in process of time, the universal use of the English language in Ireland, to the exclusion of the native speech. This method of killing a language by degrees was so effective that, before the end of the century, Irish had practically disappeared from Ireland as a written language, and survived as a spoken one only in a few districts of the south, west, and northwest. The figures showing its decline in 66 years are startling: a drop from 4,000,000 Irish speakers in 1835 to 1,524,286 in 1851, and to 641,142 in 1901, tells its own tale. Worse perhaps than the actual decline here disclosed was the neglectful or even contemptuous attitude adopted toward their own language by great numbers of the Irish people.

In the meantime, however, the great Celtic Renaissance (q.v.), which had accomplished so much in other fields, had begun to produce its effects on the moribund Irish language — slowly, indeed, at first, for the political and social unrest in Ireland from 1878 onward was an insuperable barrier to the widespread success of any mere linguistic or literary movement. The Society for the Preservation of the Irish language and the Gaelic Union did something to stem the tide; but the more ardent spirits of the latter body, dissatisfied with the progress made, and believing that, in order to achieve their purpose, a great popular movement was necessary, decided to establish another organization. To this new body was given the title of THE GAELIC LEAGUE (Cumann na Gaedhilge).

The Gaelic League was founded on 31 July 1893, at 9 Lower O'Connell street, Dublin. The number present on that historic occasion was small, seven perhaps or nine at most; but many of them were young men of great force of character and with a clear concept of what they intended to do and of the difficulties which they had to face. At the outset the three recognized leaders were John MacNeill, Rev. Eugene O'Growney, and Douglas Hyde. By using the native language as their basis of operation, they contemplated the deanglicization of Ireland and the restoration of that distinctive Irish culture which they regarded as then well-nigh lost: the re-establishment, in fact, of what came afterward to be called an Irish Ireland. The program of the League, as announced, was:

1. The preservation of Irish as the national language of Ireland and the extension of its use as a spoken tongue.

2. The study and publication of existing Irish literature and the cultivation of a modern literature in Irish.

Although conceived on strictly non-political and non-sectarian lines, the League made but slow progress at first. It had to encounter suspicion and even secret and open opposition, it had to endure the mock and the jeer of the scoffer and the scorner, and, worst of all, it had before it the herculean task of overcoming the apathy of the great majority of the people. The heads of the League, however, set about their work with courage and high hope and with a dogged perseverance, which in the long run produced results. Taking over and continuing the monthly *Irisleabhar na Gaedhilge* (The Gaelic Journal), which had been begun in 1882 by the Gaelic Union, the Gaelic League also started a weekly of its own, *Fainne an Lae* (The Ring of Day, The Dawn), which was subsequently replaced by *Claidheamh Soluis* (The Sword of Light). In time, its propaganda attracted men of all classes and all creeds, various daily and weekly newspapers helped on the movement, and a national sentiment was created. By 1905 thousands of books and pamphlets printed entirely in Irish were produced annually, and, exclusive of prayer manuals and other religious works, more books were published in Dublin in Irish than in English. In 1908, 5,814 intermediate, or secondary school, students presented themselves for examination in Irish. By 1906 close on 100,000 children were learning the Irish language in the national, or primary, schools, and the ban on the teaching of Irish history in those institutions had been lifted. A new literature in modern Irish was also in process of formation, and an Irish Texts Society was busily engaged in rescuing from oblivion the ancient Irish classics and the works of the 17th and 18th century Irish poets, like Geoffrey O'Donoghue, David O'Bruadair, Egan O'Rahilly, John Claragh MacDonnell, and Owen Roe O'Sullivan.

Among the people the principles of the Gaelic League flourished apace. Branches to the number of about 1,000 were formed not only in Ireland but also among people of Irish birth or descent in England, the United States of America, Canada, South America, and Australasia. A long-continued struggle resulted in the admission to the mails of letters, postal cards, newspapers, and parcels addressed in the Irish character, and in forcing banks to accept checks similarly signed, all of which meant that postal clerks and bank clerks with a reading knowledge of Irish had to be employed, and that Irish had to be introduced as a subject into the competitive examinations by which such officials are selected in Ireland. One week in the year was set aside as "Irish language week," and a collection for its propagation was taken up. Festivals were organized at which there were competitions in Irish story-telling, Irish dances, Irish songs, Irish music, Irish games. The national festival, the Oireachtas, held annually in Dublin from 1897, carried out these proceedings on a national scale. Under the auspices of the League, Irish concerts were held and lectures on Irish history, art, antiquities, and literature were delivered. Organizers were appointed to keep the Irish language alive in the districts where it still existed and to spread its use in others where it had decayed. Distinctive Irish schools were established and the Irish School of Learning for higher Celtic studies, with a publication of its own named *Eriu*, was founded. Similar works, like 'Gadelica' (1912–13), were from time to time brought out. Sermons were preached and public prayers were recited in Irish. A national drama in the national tongue sprang into existence and was presented by capable actors to understanding and appreciative audiences. The industrial revival in peculiarly Irish arts was due in no small degree to the spirit evoked by the Gaelic League. Its influence was also largely felt in that wonderful efflorescence of Irish literature in English which is known, *par excellence*, as the Irish Literary Revival (q.v.).

When the National University of Ireland was founded by act of Parliament in 1908 and came into being in 1909, the success of the efforts of the League was plainly discerned. In University College, Dublin, one of the Constituent Colleges of the University, there were established professorships in Celtic Archæology, in Early and Mediæval Irish History, in Early and Mediæval Irish Language and Literature, and in the National Economics of Ireland, and lectureships in Modern Irish History and in Irish Language; in University College, Cork, another Constituent College, a professorship of Irish Language and Literature and a lectureship in Modern Irish were provided; and in University College, Galway, the third Constituent College, there were founded professorships in Modern Irish Language and Literature and in Celtic Philology. Furthermore, a great agitation arose to have a knowledge of Irish made compulsory on students entering the university and up to a certain point in their undergraduate courses. A compromise on this question was finally arrived at, by which it was arranged that a knowledge of Irish was not to be essential for the first three years, but was to be obligatory thereafter. This controversy was made memorable by the declaration of the Standing Committee of the Irish Catholic bishops, who, while thinking that for the time being Irish ought to be an optional subject, yet went on record as expressing the hope that the day might come when Irish would be not only compulsory but would also be the recognized medium of instruction in the university.

Since then the Gaelic League has pursued its course, not quite so demonstratively perhaps, but none the less perseveringly. Political events, like the bitter struggle over the Home Rule bill from 1912 to 1914, the threatened revolt in Ulster in 1912, and the counter-movement of the Irish Volunteers in 1913 and 1914, as well as the advent of the great World War in the latter year and the developments to which it has led in Ireland, have tended in great measure to curtail the activities of the League. It has not yet by any means succeeded in deanglicizing Ireland, nor has it made substantial progress in extending the use of Irish as a spoken tongue. Whether it will succeed in those objects depends largely on the status of Ireland after the war. It is certain, however, that the rebellion of Easter week, 1916, and the spirit generated by its aftermath, as plainly shown in the trend of events since, are likely, when peace is restored, to give the Gaelic League a new lease of life and a fresh and stronger hold on the Irish people.

Bibliography.— Dunn, J., 'The Revival of Gaelic' (Washington 1905); Paul-Dubois, L., 'L'Irlande contemporaine' (Paris 1907); D'Alton, E. A., 'History of Ireland' (Half-Volume VI, 1879–1908, London 1910); Lennox, P. J., 'The National University of Ireland' (Washington 1910); Dunn and Lennox, 'The Glories of Ireland' (Washington 1914); Morris, L. R., 'The Celtic Dawn' (New York 1917); Boyd, E. A., 'Ireland's Literary Renaissance' (New York 1916), and 'The Contemporary Drama of Ireland' (Boston 1917).

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GAELIC LITERATURE. Although the oldest existing MSS. in Gaelic are of no earlier date than the 7th century, there is ample evidence that the literature of the Gaels, not only the traditional but the written literature, is of much greater antiquity. The internal evidence furnished by the ancient sagas, songs and chronicles preserved in mediæval manuscripts indicates a regular development extending from a period antedating by many centuries the beginning of the Christian era, down to a time well within the compass of authentic history. And both the internal and external evidence point to the existence of a written as well as a traditional literature long before the Gael came into close contact with the civilization of the other nations of western Europe.

The Gaelic, or Gaedhealg, language is an Indo-European tongue, highly inflected, and rich in beautiful forms and euphonious combinations. It is spoken in Ireland, the Highlands of Scotland and the Isle of Man. Being a Celtic tongue it is akin to the Brythonic group of languages, the Welsh, Cornish and Breton, and to the tongues, now extinct, spoken by the Celtic peoples who occupied central Europe before the extension of the Roman power. The isolation of Ireland ensured the development of the language along lines peculiarly its own, unaffected by outside influences. This is true not only of those centuries before the dawn of history, when the language was in the making, but is true also of the later period when momentous changes were stirring the rest of Europe and the modern nations were springing into being out of the fragments of the shattered Roman Empire. This isolation made for the development of a unique language and literature and it resulted, too, in the preservation and development of those peculiar social conditions, the record of which is now shedding light on a period which would otherwise be shrouded in darkness. The development of the language is usually assigned by scholars to three periods: Old Gaelic, from the earliest time to about the end of the 10th century, A.D.; Middle Gaelic, from the 11th to the 17th century; and Modern Gaelic, from the 17th century to the present day.

Though much of the old Gaelic literature came down to mediæval times in the form of oral tradition it must not be supposed that it is on that alone that its history is based. The fact that the earliest writing extant can be traced no further back than the 7th century is far from proving that previous to that time writing was unknown in Ireland. During the 8th, 9th and 10th centuries Ireland, like the other nations of Europe, suffered from the incursions of the Danes and Northmen. These marauders landed on the coast, established themselves in seaport towns, set up their own government and raided the interior. Monasteries were sacked and burned and, as in England, almost every existing book and manuscript was burned at their hands. That such manuscripts and books existed before that time, however, is amply proved. Ireland had at that time been long in touch with the rest of Europe, and her schools had supplied teachers and missionaries to the western world for centuries. During the Dark Ages, when continental Europe was plunged in almost universal war, Ireland was the home of the monastic schools, where the learning of the ages was preserved and the arts of writing and illuminating were generously fostered.

The present alphabet, which is a modification of the Roman, was introduced, it is believed, by Saint Patrick when he came in the 5th century to preach Christianity. But the art of writing was known before that. Many inscriptions have been found, especially in the southern counties, in Ogam, a system of writing which was peculiar to the early Irish. This script consisted of a series of short lines, drawn either above, below or through a stem-line. Each group of short lines represented a letter, the letter being indicated by the number and position, some being at right angles and some being at acute angles with the stem-line. This stem-line was generally the angle between two sides of a long upright rectangular stone. The vowels were indicated by very small cuts on the angle of the stone, but much larger than points. The use of Ogam was not confined to monumental inscriptions, for some small metal articles have been found inscribed with it, and the old sagas and chronicles contain many allusions to Ogam writings on poets' staves, the shields of warriors and other articles. With the introduction of the modified Roman alphabet the use of Ogam was practically discontinued, although instances of its occasional use have been discovered. In a Saint Gall manuscript of the 9th century eight Ogam sentences were discovered, and others as late have been commented on by Zeuss, Nigra and others. How Ogam was invented is still a profound mystery, but it is certain that it is peculiar to the Irish Gael and only found where he settled.

The literary form in which the primitive Gaelic genius chiefly found expression was the *sgeul*, or *ursgeul* — the saga or song-story — partly in prose, partly in verse, which recited the deeds of gods and demi-gods and heroes in spirited and dramatic fashion. Of drama, strange to say, no trace can be found in ancient Ireland; there is not a record of even a mystery or a miracle play in the early Christian days. But the romance began early and reached a very advanced stage of development, probably long before the art of writing was known. It took the form of prose narrative, interspersed with flights of spirited and highly imaginative poetry. The 'Book of Leinster,' a MS. of the 12th century, enumerates 187 of these romances and the names of many more are given in the 10th or 12th century tales of Mac Coise. Many of these tales show evidence of accretions during subsequent periods. Some of palpably pagan origin bear traces of Christian additions, such as the legend of Niul, the ancestor of the Milesians, meeting Moses and the Israelites fleeing from Pharaoh, with the miraculous healing of Niul's infant son by the Hebrew lawgiver; and the tale of the children of Lir, whose enchantment was to be ended by the ringing of the first mass-bell in Ireland. But in every instance it is an easy matter to separate the accretions from the original tale and so reconstruct the story in its primitive form.

The value to the antiquarian and student of history of the material thus obtained is incalculable. For these old hero-tales give a vivid picture of the social life of the primitive Celts, a history of the early stages of Celtic civilization, that it is impossible to find elsewhere. For although the entire of central Europe, as well as the British Isles, was peopled by Celtic tribes, the records of their civilization have been obliterated everywhere except in Ireland. The Romans, wherever they planted their standards, introduced their own civilization, wiping out of existence whatever antedated their coming, and their historians, writing of the Roman conquests, measured everything by a Roman standard and found nothing worthy of record in the culture of the barbarian. Hence, practically all record of the continental Celt prior to his subjugation by the Roman has been lost. But the Roman legions never secured a foothold in Ireland, and the Gaelic Celt worked out his own destiny without interference. The record of this development is found in his traditional literature and is proving a mine of invaluable material for the investigator of conditions in ancient Celtic Europe. The most important of these sagas resolve themselves into three distinct groups, representing three periods of the history of the race: The Mythological Cycle; the Heroic, or Red Branch Cycle; and the Fenian or Ossianic Cycle.

The Mythological Cycle.— In the oldest Gaelic sagas the confusion of gods and men is baffling. . So thoroughly have the ancient deities been euhemerized that later generations came to look upon them simply as earlier races of inhabitants. These romances tell the story of successive settlements of Ireland. They tell of Partholan and his followers who were the earliest settlers; of Nemedh, who followed and possessed himself of the land; of the Fomorians, who conquered the Nemedians and drove them out; of the return some centuries later of the descendants of a part of the Nemedian force, now known as Firbolgs, to dispute with their former conquerors, and the subsequent return of the descendants of another division of the Nemedians, the Tuatha de Danaans, who in turn became masters of the land, holding it until the coming of the conquering Scots, or Gaels, or Milesians as they are variously called. The saga of the 'Battle of North Moytura' tells of the fight between the Tuatha de Danaans and the Firbolgs, which resulted in the utter defeat of the latter, who were driven into the smaller islands. This story and the story of the 'Battle of South Moytura' between the Tuatha de Danaans and the Fomorians, abound in descriptions of the marvelous achievements of the heroes and ends in the complete defeat of Fomorians. To this period belongs also the pathetic tale of the 'Death of the Children of Tuireann,' included by Hyde in 'The Three Sorrows of Story-Telling.'

The Red Branch, or Heroic Cycle.— This group of tales deals with the history of the Milesians, the warlike race which finally conquered the island and held it until the coming of the English. Unlike the earlier tales, which palpably treat of a fabulous age and purely mythical persons and events, these romances deal with a world which has an apparent basis of reality, despite the legendary character of many of the events there recorded, and of the heroes who participate in them. The people of this cycle, Cuchulain, Conall Cearnach, Deirdre, Naoise, Meve, Conor mac Nessa, Fergus mac Roigh, though of heroic stature, are yet human; their deeds, and the motives for those deeds, are human; and though the marvelous and the preternatural are found there in as marked a proportion as in the 'Iliad' and the 'Odyssey,' they do not dominate as in the tales of the Mythological Cycle. This group of romances is, without question, the finest in all the ancient Irish literature. The period, which is identified by the annalists with the birth of Christ and the beginning of the Christian era, is associated chiefly with the long war between Connaught and Ulster arising out of the murder of the children of Usnach. This incident is recorded in one of the most beautiful and pathetic tales in the whole range of ancient story-telling, the tale of 'Deirdre, or the Fate of the Children of Usnach.' Cuchulain, the Ultonian champion, is the great hero of this cycle. Conall Cearnach, Ferdiad and Meve, the warrior-queen, are figures hardly less heroic. The most important of the romances of this group is the 'Tain Bo Cuailgne,' or the 'Cattle-Spoil of Cooley,' a tale that has proved a valuable source of information for the antiquarian from the light it throws on early Celtic life and manners. The 'Death of Conlaoch' is a curious parallel of the story of Sohrab and Rustum.

Fenian or Ossianic Period.— Though Cuchulain is the great hero of the heroic age of the Gael, there is another of a later age who comes closer than he to the popular heart. Fionn, or Finn, mac Cumhail, if one may judge by the affectionate reverence with which his name and the records of his deeds are preserved in peasant lore, is without question the most popular of the traditional heroes. While the wonderful achievements of the elder hero are familiar to the scholar, those of Fionn are known to every unlettered peasant and are embalmed in folksongs and folktales without number. Moreover, the whole body of Fenian story is intimately bound up in the popular interest. Hyde points out that for a period of from 1,200 to 1,500 years these tales showed a most remarkable instance of continuous literary evolution. Century after century saw accretions in the form of stories and poems about Finn and the Fenians, and there are to-day extant in Gaelic-speaking communities numberless stories that have never been reduced to writing in which Finn is the central figure. This was never, at any time, true of Cuchulain and the Red Branch Cycle. Finn is distinctively the popular hero, the hero who stands in the popular imagination for all that is heroic and patriotic.

Like Cuchulain, he is the central figure of a cycle of romance, almost as important as the Red Branch Cycle. The Fenian Cycle, so-called from the fact that it deals largely with the Fianna, or Irish Militia; or the Ossianic Cycle, from Ossian, or more properly Oisin, the son of Finn, who is credited with the authorship of many of the poems, comes nearer than either of the other cycles to the limits of authentic history. These sagas treat of such historical personages as Conn of the Hundred Battles, Ard-Ri (High-King), whom the annalists assign to the 2d century; his son, Art the Lonely; his grandson, Cormac mac Art (A.D. 227, according to the "Four Masters;" 213, according to Keating); and his great-grandson, Cairbre of the Liffey. Finn, himself, is generally accepted as an historical figure, though much of myth and romance has been woven into his history. The earliest, in point of the chronology of the romances of this period, is the tale of the 'Battle of Cnucha,' in which Cumhail, the father of Finn, is killed by Conn of the Hundred Battles. Thence through a long cycle of romances the many adventures of Finn and his redoubtable band of warriors, Oisin, his son, Oscar, his grandson, Caoilte, the poet, Diarmidh and many another, are related until in the 'Battle of Gabhra,' which closes the series, is told how Cairbre of the Liffey broke the power of the Fenians forever.

The most fascinating, and when everything is considered, perhaps the most meritorious of the Fenian sagas is the 'Pursuit of Diarmidh and Grainne.' Like the story of 'Deirdre,' despite its antiquity the human appeal is almost modern, so close does it come to our own manner of thought. It tells of Finn's suit for the hand of Grainne, daughter of Cormac mac Art, the High-King; Grainne's passion, developed while the negotiations for her hand were in progress, for Diarmidh of the Love-Spot, one of Finn's warriors; the flight of the pair and the pursuit of the vengeful Finn.

Miscellaneous Romances.— Besides the stories of the three main groups above enumerated, there is a considerable number of sagas, some as old as those of the Red Branch Cycle, and some more recent, which cannot well be included under any of these headings. The most important is the 'Bruidhean of Da Derga,' a Leinster tale of the Red Branch period; and others that fall under this same heading are 'The Dream of Mac Conglinne,' a satire full of an irresistible humor; the 'Voyage of Maelduin' and the 'Battle of Moy Rath.'

Early Christian Period.— With the coming of Christianity came a new phase of Gaelic literature. Saint Patrick and his followers found a soil ready to receive the seed of Christianity. Theirs was a bloodless conquest, and although the Bardic Schools struggled long against the innovation of Christianity they at length succumbed and the subsequent literature of Ireland is thoroughly Christian and largely devotional in tone. Saint Patrick himself was a man of works rather than a man of letters, and yet it is to him that the earliest literature of Christian Ireland and, if we except the Ogam inscriptions, the earliest authentic writings now in existence can be traced. Of the 'Canon Phaidraig,' or 'Patrick's Testament,' a MS. copy of the late 8th or early 9th century is still in existence, and this, it has been demonstrated, was made from an older copy in the saint's handwriting. The authenticity of 'Saint Patrick's Confession,' which, strictly speaking, is not a confession but an apology, has been questioned, but it is vouched for by such eminent authorities as Stokes, Todd and Hyde. These two works, it is true, are in Latin and might be excluded from a consideration of purely Gaelic literature, but as they are the first literary utterance of Christian Ireland, they are worthy of note, despite the alien tongue in which they are written. This objection, however, does not apply to the 'Epistle to Coroticus' and 'The Cry of the Deer,' two compositions in Gaelic which are also attributed to Saint Patrick. Seachnall, a nephew of the great apostle, is looked upon as the first Christian poet in Ireland, although he, too, wrote in Latin.

Biography, chronicle-history and genealogy make up a large part of the remains of Gaelic literature and, as might be expected from the fervor with which the Irish adopted Christianity, the literature of this period is rich in lives of the saints. It is appropriate, too, that among the earliest we should find lives of Saint Patrick. The 'Book of Armagh' contains two very early biographies. There are many others, but the most important is the 'Tripartite Life,' the MS. of which, written in ancient Gaelic, was discovered by O'Clery, one of the "Four Masters," early in the 17th century. This "Life" might, perhaps, be more fittingly described as a group of three semi-historical homilies on the life of the saint. Saint Columcille (521–597), after Saint Patrick the most renowned of the early churchmen, contributed generously to the Gaelic literature of this period. His Gaelic poems voice an ardent patriotism, those written after his exile to Iona especially breathing a passionate love for the land of his birth. The same century that knew Saint Columcille boasts of another great churchman and writer, Saint Brendan the Navigator, founder of the famous abbey and school of Clonfert. Saint Brendan is the reputed author of the 'Navigatio Brendani,' a tale of marvelous romance, the influence of which was felt throughout Europe. MS. copies of it may be found in many monasteries on the Continent, and it has been edited and annotated in many tongues. Giraldus Cambrensis (1146?–1220?) alludes to it as being well known in his time. The life of Saint Brendan in the 'Book of Lismore' tells of his setting out in three vessels in search of an isle in the west which was to be a land of promise, probably the Moy Mell and Hy Brassil of the ancient pagan legends.

But it must not be supposed that the making of literature in Ireland was confined to the churchmen. The arts of poetry and prose composition flourished after, as before the coming of Christianity, and the race of bards did not die out for many centuries. Notable among those who flourished prior to the period of the Danish incursions was Eochaidh, better known as Dallan Forgaill, a contemporary of Saint Columcille. He was Chief Ollamh of Ireland, a dignity which on his death devolved on his pupil, Senchan Torpeist. Others, equally as important, were Cernfaeladh (c. 678) and Angus Céile Dé, or the Culdee. The 'Saltair na Rann,' a collection of 162 poems in Early Middle Gaelic, giving a rather fanciful account of the creation of the world and the fall of Adam and Eve, was long attributed to Angus, but later research by Whitley Stokes has shown that it could not have been written earlier than 1000.

Danish Occupation to Norman Invasion. — Despite the continual warfare and waste of life and property that marked the two or three centuries of Danish occupation of Ireland, literature and learning flourished. Cormac mac Culinan (d. 908), king, and bishop of Cashel; statesman, ecclesiastic, poet and scholar, is the most eminent figure at this stage of Gaelic literary development. 'Cormac's Glossary' is the earliest attempt at a comparative vernacular dictionary made in any language of modern Europe. It is valuable not only as an example of early scholarly effort, but also for the light it throws on pagan customs, on law, history and romance. The 'Saltair of Cashel,' also the work of Cormac, has been lost. Others of lesser fame have left examples of their work, the most noted of them being Cinaeth O'Hartigan, Eochaidh O'Flynn and Mac Liag, bard to King Brian Boroimhe, the monarch who in the decisive battle of Clontarf (1014) defeated the Danes and broke forever their power in Ireland. Mac Liag and Errard mac Coise are credited with the joint authorship of the valuable chronicle, 'The Wars of the Gael with the Gall' (i.e., Norsemen), the accuracy of which has withstood some very remarkable tests of modern scholarship. Clontarf saw the end of the Scandinavian power in Ireland, and the 11th and 12th centuries witnessed a great revival of learning. The industrial arts, architecture, letters, all flourished, and it is to this period that we are indebted for the three most important relics of Celtic literature now in existence: the 'Leabhar na h-Uidhre,' the 'Book of Leinster' and the 'Book of Hymns.' Tighearnach, abbot of Clonmacnois, the great annalist, and Flann, head-teacher of the school of Monasterboice, chronologist and poet, are the most eminent individual figures. Irish scholars traveled to the Continent and left the impress of their learning on many a European school.

Arrest of Development and Subsequent Revivals.— With the Norman invasion in 1169 came the arrest of development. Hitherto wars, whether between the septs or with foreign invaders, did no lasting injury to the intellectual or æsthetic development of the race, but with the coming of the Normans began a period of decay that lasted for four centuries. The tradition of poetry was kept alive, but no great names illumine the record, and it is not until the beginning of the 17th century that we find a reawakening of the literary spirit. With this period came the last great outburst of classic Gaelic poetry. Teig mac Daire is looked upon as the last of the classic poets and the greatest of his time, although Lughaidh ua Clerigh, with whom he engaged in a notable controversy («The Contention of the Bards»), is also conspicuous for the merit of his poetry. Others whose work has survived were Teig Dall O'Higin and Eochaidh O'Hussey.

This period, too, saw some of the earliest and most notable achievements in the field of antiquarian research and compilation of annals. Chronicle-history and genealogy had been favorite fields of literary effort for the Gael from the earliest time, but this period brought to the ancient labor the resources of mediæval scholarship and the habit of study bred in the monastery. Among the chroniclers of the 17th century we find men of acknowledged learning and skilled in antiquarian research, such men as Brother Michael O'Clery, the learned Franciscan, who compiled the 'Reim Rioghraidhe («Succession of Kings») and the 'Leabhar Gabhala' («Book of Invasions»); and who, with O'Mulconry, O'Duigenan and Peregrine O'Clery, compiled that greatest of all mediæval Irish chronicles, the 'Annals of the Four Masters.' This work, covering the whole field of Irish history, legendary and authentic, is the most comprehensive and exhaustive record of the kind in the language. Others equally eminent were Duald mac Firbis, the genealogist; and Geoffrey Keating, theologian, poet and historian, whose 'History of Ireland' is a model of Gaelic prose. Keating, in one sense the greatest of these, was the first to depart from the dialect of the learned, the ancient bardic idiom, and write in a popular style. All his predecessors were learned men writing for the learned few; he, a learned man, writing for the many. His history was the most popular book ever written in Gaelic. In his poetry, as in his prose, he was an innovator and was the first to depart from the ancient metres.

The metrical systems of the old bardic schools were intricate and elaborate and, technically, had reached an advanced stage of development at an early period. The underlying principle was not alliteration as in Anglo-Saxon and other Teutonic verse; or quantity as in the metres of the Classic tongues, but a consonantal rime, based on a division of the consonants into groups, any consonant in a particular group riming with any other consonant in that group. The syllables, too, were reckoned, but without regard to stress. It was an intricate system, and ease of composition according to it could be acquired only after years of arduous labor over its technicalities. But with the breaking up of the bardic schools in the 17th century came the introduction of a new verse-form in which accent and not syllable was the unit of measure and in which vowel rime took the place of consonantal. The change was almost instantaneous, and with the introduction of the simpler form the whole nation seemed to burst into song. The new method was elaborated and developed until the rime affected every accented syllable in the line, with a result that was wonderfully melodious. «The Gaelic poetry of the last two centuries both in Ireland and in the Highlands,» says Hyde 'Literary History of Ireland,' 1903, p. 542, «is probably the most sensuous attempt to convey music in words, ever made by man. It is absolutely impossible to convey the lusciousness of sound, richness of rhythm, and perfection of harmony, in another language. Scores upon scores of new and brilliant metres made their appearance.»

Eighteenth Century and After.—The 18th century was a period of persecution, and with the means of education and the opportunities for bettering themselves denied them, the Irish people found an outlet for their feeling only in song. The number of poets produced is almost countless, but a few names, such as David O'Bruadar, John O'Neaghtan, Torlogh O'Carolan, Tadhg Gaoloch O'Sullivan, Donough Mac Conmara and Brian Mac Giolla Meidhre, are worthy of special mention. But with the 18th century the history of Gaelic literature practically ends. Through the early years of the 19th century the struggle to preserve it was kept up, but the famine, coming as the climax of a long series of calamities, put an end to it. Such men as O'Curry, O'Donovan, Petrie and Todd; such societies as the Ossianic Society and the Society for the Preservation of the Gaelic Language, labored for the salvation of the tongue, but it was not until the great popular movement of the last two decades of the century that any real progress was made. The Gaelic League during that time stirred the nation to a sense of its impending loss and as a result the study of the language has been taken up with enthusiasm not only in Ireland but in the United States, South America and Australia. Although this movement, which is purely popular and patriotic and has for its object the restoration of the language and the literature, is distinct from the scholarly interest shown by such scholars as Zeuss, Zimmer, Kuno Meyer, Windisch, D'Arbois de Jubainville, Whitley Stokes, yet its indebtedness to the researches of these investigators is unquestionable. That indebtedness is greater, however, to men like Dr. Douglas Hyde, Dr. Sigerson, Rev. Eugene O'Growney, Rev. P. J. Dineen, Rev. Peter O'Leary, Lady Gregory and others, who couple with thorough scholarship an enthusiasm that makes their efforts doubly effective. Dr. Hyde is a poet of undoubted gifts, with a command of Gaelic and the intricacies of its metres as sure as is his command of English, and a prose writer of equal fluency in both languages. Father O'Growney's series of textbooks is the standard course in most of the classes, and the others have contributed generously to the product of the new school. See also CELTIC LANGUAGES.

Bibliography.— Hyde, 'A Literary History of Ireland' (3d ed., New York and London 1903); 'Love Songs of Connaught' (London 1895); 'Religious Songs of Connaught' (Dublin 1906); Joyce, 'Ancient Social Ireland' (2 vols., London and New York 1903); Stokes and Strachan, 'Thesaurus Palæonibernicus'; Sigerson, 'Bards of the Gæl and Gall' (London 1907, 2d ed.); Stokes, 'Irish Lives' and 'Three Middle Irish Homilies'; Thurneysen, 'Mittelirische Verslehren'; Stokes and Windisch, 'Irische Texte' (Leipzig 1881–1900); Anwyl, 'Celtic Religion in pre-Christian Times' (1906); Strachan, 'Old-Irish Paradigms and Selections from Old-Irish Glosses' (1909); O'Grady, 'Silva Gadelica' (London 1892). Numerous texts can be found in the *Revue Celtique*, the *Zeitschrift fur Celtische Philologie*, the *Anecdota Oxoniensia*, and the Irish Text Society, the Irish Archæological Society, the Celtic Society and the Royal Irish Academy.

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GAETA, gä-ā'tä, a city and seaport of Italy and one of the most strongly fortified maritime cities of the country, located in the province of Caserta on the Gulf of Gaeta, 74 miles by rail northwest of Naples. It is picturesquely situated on an abrupt promontory projecting into the Mediterranean and connected with the mainland by a low and narrow isthmus protected by solid walls. On the summit of the promontory stands the circular tower D'Orlando, said to be the ancient mausoleum of Lucius Munatius Plancus, friend of Augustus. Many interesting classic remains have been found in Gaeta, including a fine marble vase by the Athenian sculptor Salpione, the ancient campanile of the cathedral of Saint Erasmus and the remains of a Roman theatre and a Roman amphitheatre.

The inhabitants of Gaeta derive their chief profits from the fisheries and their coasting-trade in oil, wine and fruit — principal productions of the surrounding country. Cajeta, ancient name of Gaeta, derived its origin, according to tradition, from its being the burial-place of Caieta, the nurse of Æneas. On the dismemberment of the Roman Empire, Gaeta became a centre of civilization and commercial prosperity, and gained still more importance after the decadence of the Eastern Empire. It successively withstood the invasions of the barbarians and the Lombards and Saracens. Both in ancient and modern times, Gaeta has sustained remarkable sieges, and recently it has been the theatre of several interesting events. In 1134 it fell before Roger II, and was annexed to the Norman kingdom of Sicily. In 1806 it was defended for six months by Prince Ludwig von Hessen-Philippsthal against the forces of Masséna. From 1848–50 it was the refuge of Pope Pius IX, when the revolution at Rome compelled him to retire. In 1860 after the defeat of the Neapolitans on the Volturno by the forces of Garibaldi, Gaeta was the last stronghold of the Bourbon dynasty of Naples, and after a protracted siege lasting from November 1860 to 13 Feb. 1861 Francis II of Naples surrendered the city to General Cialdini. Pop. about 6,000.

GAFF, in a ship or boat, spar or a sort of boom to which the head of a fore-and-aft sail is bent, such sail having its foremost side made fast by rings to the mast, and its lower edge, in most instances, held straight by the boom proper. The thick end of the gaff is constructed with «jaws» to pass half round the mast, the other half being inclosed by a rope or wire; this serves to keep it close when the sail is hoisted or lowered. The jaws are usually made by fastening two pieces of wood by means of bolts to the thick end of the gaff, the forward side of these pieces being hollowed out in the form of a semicircle so as to fit snug to the mast but sufficiently loose to allow of free play for the hoisting and shifting of the sail. Lately these jaws have been made entirely of metal, chiefly bronze. The after end of the gaff is called the «peak,» because it is usually raised much higher than the jaws when the sail is set. The ropes used in hoisting and lowering the gaff are called «halyards,» the rope for raising the peak being designated the «peak-halyard» and that near the «jaws» or «throat» the «throat-halyard.» «Spankers» and «trysails» are the only ones which have gaffs in square-rigged ships, but these gaffs do not ordinarily lower or hoist and in place of jaws have eyelets holding the forward end to the mast or to a traveler working on a batten to the mast. The latter method, however, is preferable as the gaff may be lowered when the sail is reefed.

GAFFAREL, gäf-fä-rĕl, **Paul (Louis Jacques)**, French historian: b. Moulins 1843. He received his education at the École Normal Supérieure; was made professor of history at Besançon, removing afterward in a similar capacity to Dijon and Marseilles. He has published many noteworthy works on colonial history; these include 'Étude sur les rapports de l'Amérique et de l'ancien continent avant Christophe Colomb' (1869); 'Histoire de la Floride française' (1875); 'Histoire du Brésil français' (1878); 'Les colonies françaises' (1880); 'L'Algérie: histoire, conquête et colonisation' (1882); 'Les explorations françaises de 1870 à 1881' (1882); 'Les campagnes de la première République' (1883); 'La conquête de l'Algérie jusqu'à la prise de Constantine' (1887); 'Les Français au delà des mers' (1888); 'Campagnes du Consulat et de l'Empire' (1888); 'Campagnes du premier Empire' (1890); 'Le Sénégal et le Soudan français (1890); 'Histoire de la découverte de l'Amérique (2 vols., 1892); ‹Le politique coloniale in France de 1789 à 1830› (1908).

GAFFKY, Georg Theodor August, German physician: b. Hanover 1850. He was educated at the University of Berlin and in 1888 was appointed to the chair of hygiene at the University of Geissen. In 1883–84 he visited Egypt and India as member of an expedition to study epidemics of cholera. He gathered much valuable material which he published three years later in collaboration with Dr. Koch. In 1892 during a cholera epidemic at Hamburg he was adviser to the municipality and in 1897 again visited India to make further studies of cholera. He became director of the Institute for Infectious Diseases at Berlin in 1904. His published works include ‹Zur Aetiologie des Abdominaltyphus› (2 vols., 1884); ‹Die éxperimentelle Hygiene in Dienst der öffentlichen Gesundheitspflege› (1895).

GAFFNEY, S. C., city and county-seat of Cherokee County, 110 miles northwest of Columbus, on the Southern Railway. Its industries comprise cotton and cotton-seed-oil mills, fertilizer works, lime, fibre works, tin and monazite mines, etc. It has extensive cotton-growing interests; has a woman's college, a Carnegie library, several schools and churches, and owns and operates the electric-lighting plant and the water supply system. Pop. 4,800.

GAG-RULES, a series of rules adopted 1836–44 by the House of Representatives, to prevent the reception of anti-slavery petitions and check the possibility of debate on the subject. No other measure created more virulent debate. The Constitution forbids Congress to pass any law «abridging the right of the people to petition the government for a redress of grievances,» and impliedly to refuse to receive petitions, as an unheard petition is a nullity. From 1831 on, the abolition societies rained petitions on Congress, urging the abolition of slavery in the District of Columbia, over which it had complete legislative power. They were referred to the Committee on the District, which at first reported adversely, then ceased to report at all, despite complaints. The 24th Congress, 1835–36, laid them on the table instead; but in both Houses there soon arose an outcry to bar them from congressional cognizance altogether. In the Senate, Calhoun on 7 Jan. 1836 moved not to receive two such petitions, on the ground that the South must in the end be worn out and degraded by having constantly to justify its institutions before a body which had no jurisdiction over them anywhere; but after two months' debate, it was voted to receive them and they were immediately rejected, which remained the rule thereafter. In the House, on 8 February, Henry L. Pinckney of South Carolina moved that all the petitions be referred to a select committee, under instructions to report that Congress could not constitutionally interfere with slavery in the States, and ought not to do so in the District; on 18 May the committee so reported, with another resolution that all petitions relating to slavery be laid on the table without action or reference. Under the previous question both resolutions were passed 25–26 May; the last 117 to 68, John Quincy Adams refusing to vote and denouncing them as a violation of the Constitution, the rules of the House and the rights of his constituents. Thereafter Mr. Adams, as the champion of the right of petition, became involved for years in an endless struggle against the «gag.» On 18 Jan. 1837 this struggle was renewed. The furious scenes in which Mr. Adams was pitted against nearly all the rest of the House are among the most picturesque in American history. On 21 Dec. 1837, John M. Patton of Virginia moved and secured the passage (122 to 74) of a resolution to lay on the table without debate, reference or action, all papers concerning slavery in any State, «District or Territory» of the United States. Adams again denounced it and refused to vote. On 11 Dec. 1838 the «Atherton Gag» was moved by Charles J. Atherton of New Hampshire, and passed 126 to 73; it was the same in essence as the others. On 21 Jan. 1840 the House adopted as its 21st Rule that no paper praying the abolition of slavery or the slave trade should in future be received by the House or entertained in any manner. But this only passed by 114 to 108; the refusal of the right of petition was incensing the North, and forcing even Democratic representatives to protest. Thereafter at every session, in adopting the rules, Mr. Adams moved to strike out the 21st. The violence of the assaults on him increased, but the majorities against him decreased. At the special session of 1841 his motion was carried on a motion to adopt the rules only for 10 days, but reconsidered and defeated. Finally, on 3 Dec. 1844 a motion to lay his motion on the table was lost by 104 to 81, and the 21st Rule was abolished by 108 to 80. Nothing of the kind was again attempted. Since 12 Dec. 1853 petitions are no longer presented in the House, but handed to the clerk. Consult Adams, ‹Memoirs› (Philadelphia 1874–77); Benson, ‹Abridgment of the Debates of Congress 1789–1856› (New York 1857–61); ‹Thirty Years' View› (New York 1854–56); Wilson, ‹Rise and Fall of the Slave Power in America› (Boston 1872–77).

GAGARIN, gä'-gä-rēn, **Alexander Ivanovich**, Russian soldier: d. 1857. He distinguished himself in the campaigns in the Caucasus especially in the Dargo expedition, and in 1847 became military governor of Kutais; in 1853 he took command of the troops on the Turkish frontier, becoming afterward commander of the 18th Infantry division. He was seriously wounded at Kars and in 1857 returned to his duties at Kutais as governor-general. He was charged with the subjugation of Suanethea and ordered to bring the prince of that province to Tiflis. The latter, Constantin Dadeschkalian, surprised Gagarin in his castle and inflicted on him wounds from which he died a few days afterward.

GAGARIN, Ivan Sergeyevich, Russian diplomat and churchman: b. 1814; d. 1882. He was a member of the princely house of Gagarin; entered the diplomatic service of his country and became secretary of embassy at Paris. He was converted to the Catholic faith in 1843, and subsequently entered the Jesuit order. He wrote ‹Les starovères, l'église russe et le pape› (1857); ‹Les hymnes de l'églin russe› (1868).

GAGARIN, Matthew Petrovich, Russian prince and statesman: d. 1721. In 1703 he was governor of Nertchinsk and four years later became president of the Siberian Chamber. He was named governor of Moscow in 1708, and after 1711 was governor of Siberia. After administering this office for a few years he was charged with various offenses, especially with a project of separating Siberia from the empire and constituting it a separate and independent nation. He spent two years in prison, was tortured frequently and finally put to death by Peter the Great.

GAGE, Lyman Judson, American financier: b. De Ruyter, N. Y., 28 June 1836. His family moved to Rome, N. Y., in 1848, and he was educated at the Rome Academy. He worked in the Oneida Central Bank 1853–55, when he went to Chicago, becoming a clerk, and later bookkeeper and cashier of a planing-mill company. In 1868 he became cashier and in 1891 president of the First National Bank of Chicago. He was the first president of the board of directors of the World's Columbian Exposition, and several times president of the American Bankers' Association and the Civic Federation of Chicago. On 5 March 1897 he was appointed Secretary of the Treasury, by President McKinley; in 1901 was reappointed; resigning in March 1902. He received the degree of LL.D. from the New York University, 4 June 1903. He was the originator of the movement for civic reform which started in Chicago under his inspiration and became a national influence. He wrote the platform of the Economic Conferences, a unique feature of Chicago's social organization, where Republican and Democrat, rich and poor, conservative and anarchist, meet for debate and exchange facts and theories.

GAGE, Simon Henry, American embryologist: b. Maryland, Otsego County, N. Y., 20 May 1851. In 1877 he was graduated at Cornell University and in 1878–81 was instructor, in 1881–89 assistant professor, and in 1889–93 associate professor of physiology at Cornell. From 1893 to 1895 he was associate professor of anatomy, histology and embryology and in 1895–96 professor at the same institution. In 1906 he became professor of histology and embryology emeritus after 25 years' service to undertake special investigations, on an allowance from the Carnegie Foundation for the Advancement of Teaching. He is coeditor of the *American Journal of Anatomy* and is a member of many scientific societies, American and foreign. He is the author of 'The Microscope and Microscopic Methods' (12th ed., 1916); 'Anatomical Technology,' with B. G. Wilder; 'Optic Projection with the Magic Lantern and the Moving Picture Machine' (1913–14); also numerous papers on biological subjects; collaborator to Foster's 'Encyclopædic Medical Dictionary'; Wood's 'Medical Dictionary' and Wood's 'Reference Hand Book of the Medical Sciences,' etc.

GAGE, Thomas, English general: b. Firle, Sussex, 1721; d. 2 April 1787. He was son of first Viscount Gage and was educated for the army which he entered as lieutenant in 1741. He took part in the battle of Culloden and served in Flanders as aide-de-camp to Lord Albemarle. Appointed lieutenant-colonel of the Forty-fourth Foot in 1751, he came with it to America three years later with General Braddock. In 1755 he accompanied Braddock's ill-fated expedition as lieutenant-colonel. In 1758, while stationed at Oswego, he raised and trained a regiment of provincial troops for Abercrombie's expedition against Ticonderoga. The following year he became brigadier-general with command at Niagara. He was appointed by General Amherst, in 1760, military governor of Montreal, and in 1763 commander-in-chief of the British forces in America. His inflexible character led the government to regard him as well fitted to end the disturbances in the American colonies. In 1774 he was nominated governor of Massachusetts, a post of peculiar difficulty, and his enforcement of the rigorous decrees of Parliament brought matters to a climax. On the night of 18 April 1775 he dispatched an expedition to seize a quantity of arms which had been stored at Concord; and next day took place the memorable encounter of Lexington, which announced that the Revolution had begun. The battle of Bunker Hill (q.v.) made him unpopular. For a short time he was commander-in-chief in America, a post he soon resigned to return to England.

GAGER, (Charles) Stuart, American botanist: b. Norwich, N. Y., 1872. In 1895 he was graduated at Syracuse University and later studied at Harvard and Cornell. In 1897–1905 he was professor of biological science and physiography at New York State Normal College; from 1906 to 1908 was director of the laboratories of the New York Botanical Garden and in 1908–10 was professor of botany at the University of Missouri. Since 1910 he has served as director of the Brooklyn Botanical Garden. His publications include 'Errors in Science Teaching' (1901); 'Effects of the Rays of Radium on Plants' (1908); 'Non-Technical Lectures' (1913); English translation of De Vries, 'Intracellular Pangensis' (1910).

GAGNON, găn'yôn, **Charles Alphonse Nathanaël,** Canadian author: b. Port Joli, Quebec, 1851. He received his education in the public schools; entered journalism at Montreal and afterward moved to Quebec. He was reporter in the courts there and afterward secured a position from the provincial government in the Department of Public Works. His tales, sketches, etc., include 'Douleurs et Joies' (1876); 'Geneviève, Saint Jean, Port Joli' (1876); 'Quelques considerations pour les temps actuels' (1882); 'Les banques d'epargnes scolaires' (1887); 'Études archæologiques et variétés) (1894); 'L'Amérique précolombienne; essai sur l'origine de sa civilisation' (1908).

GAHNITE, gä'nīt, "zinc spinel" (named after J. Gottlieb Gahn, a Swedish chemist and mining engineer), a zinc-aluminate, $Zn\ Al_2O_4$. The variety automolite has this formula; in kreittonnite the zinc is in part replaced by ferrous iron and magnesium, and the aluminum by ferric iron. The variety dysluite is similar except that manganese is present instead of magnesium. Gahnite usually occurs in octahedrons of a black, gray, dark green or brown color, with a hardness of 7.5 to 8. Its most important localities are in Sweden, Bavaria and Sussex County, N. J.

GAIL HAMILTON. See DODGE, MARY ABIGAIL.

GAILLARD, gī'yär', **Claude Ferdinand,** French painter and engraver: b. Paris, France, 7 Jan. 1834; d. there, 19 Jan. 1887. He was a pupil of Léon Cogniet and studied painting and engraving at École des Beaux-Arts. In 1856 he gained the Prix de Rome. Among his pictures are 'The Education of Achilles' (1863); 'Saint Sebastian' (1876); 'Christ at the Tomb' (1877), besides several portraits and some copies of old masters. His principal engraved portraits are 'Chateaubriand,' 'Monseigneur Bouvier,' 'Count of Chambord,' 'Monseigneur Merode.' 'The Plates of Saint Sebastian,' of one of Botticelli's 'Holy Families' and of the 'Man With the Pink,' of Van Eyck, rank among the masterpieces of modern engraving. Gaillard gained three medals for engraving and one for painting, and was decorated with the cross of the Legion of Honor in 1876. Consult Beraldi, H., 'Les graveurs du dix-neuvième siècle' (Paris 1885–92).

GAILLARD, gāl'lerd, **David Du Bose**, American soldier and engineer: b. Sumter County, S. C., 1859; d. 1913. In 1884 he was graduated at the West Point Military Academy and from 1891 to 1894 was a member of the International Boundary Commission of the United States and Mexico. In 1895–98 he superintended work on the Washington aqueduct and during the war with Spain was colonel of a regiment of volunteer engineers. In 1909 he was made lieutenant-colonel in the regular army. In 1907 he was appointed on the Isthmian Canal Commission and was made director of the Panama Railroad Company. In 1908 he was made engineer of the division of the Panama Canal from Gatun to Pedro Miguel. He wrote 'Wave Action in Relation to Engineering Structures' (1904).

GAILLARDET, gī-yär-dā, **Théodore Frédéric**, French dramatic author: b. Auxerre, 7 April 1808; d. Plessis-Bouchard, 12 Aug. 1882. He practised law at Tonnerre. He sent a drama to the Porte Saint-Martin, which partly rewritten by Alexander Dumas, the elder, and signed by him, achieved an enormous success as 'La Tour de Nesle,' 28 May 1832. This led to a duel with Dumas, Gaillardet afterward gaining a lawsuit which permitted him to place his name as one of the authors of the piece. He is the author of two other plays, 'Struensée ou le Médecin de la Reine' (1832) and 'Georges, ou le Criminel par Amour' (1833). He also wrote from private papers found at Tonnerre and the archives of foreign affairs the 'Mémoires du Chevalier d'Eon' (1836, new ed. 1866). Coming to New York in 1839 he founded the *Courrier des Etats Unis*, a French newspaper, which he edited until 1848 and which is still published. He returned to France later and served on the editorial staff of the *Presse*.

GAILLARDIA, a genus of plants of the family *Asteraceæ*, composed of about 20 species, natives of western North America. They are annuals or perennials with toothed leaves, bearing usually very showy heads, surrounded by yellow and red rays. Some of the species are common in cultivation.

GAILOR, Thomas Frank, American Protestant Episcopal bishop: b. Jackson, Miss., 17 Sept. 1856. He was graduated from Racine College, Wisconsin, in 1876, and from the General Theological Seminary, New York, in 1879. Entering the ministry he was rector of the Church of the Messiah, Pulaski, Tenn., 1879–82; and in 1882 became professor of ecclesiastical history in the University of the South, Sewanee, Tenn. In 1893 he was consecrated bishop-coadjutor of Tennessee, and in 1898, on the death of Bishop Quintard, became bishop of Tennessee. Elected chancellor and president of board of trustees of the University of the South, Sewanee, Tenn., 1908. He delivered 'Bedell Lectures on the Christian Church and Education' (1908). His writings include 'A Manual of Devotion'; 'The Apostolical Succession'; 'Things New and Old'; 'The Trust of the Episcopate'; 'The Episcopal Church — The Prayer Book, History, Ministry' (1914).

GAINES, Edmund Pendleton, American army officer: b. Culpeper County, Va., 20 March 1777; d. New Orleans, 6 June 1849. He was appointed second lieutenant in the Sixth regiment, United States Infantry, in 1799; in 1805 became collector of customs of the port of Mobile, Ala., and received the rank of captain 1807. Serving through the War of 1812, he became brigadier-general in 1814, commanding at Fort Erie, in August, until wounded. He afterward became brevet major-general; commanded the Southern Military District during the first war against the Seminoles 1817, the Western District 1821, being wounded in the second war with the Seminoles in 1837, and the Department of the Southwest when war was declared with Mexico.

GAINES, Myra Clark, American claimant: b. New Orleans 1805; d. 1885. She was a daughter of Daniel Clark, who emigrated from Ireland to New Orleans and inherited his uncle's property there in 1799. He was supposed to have lived a bachelor, but it was known that he was the father of two daughters by a French woman of great beauty. He died in 1813; his will gave his property to his mother. In 1830 letters were found detailing the circumstances of Myra's birth; in 1832 one that gave an account of a will made by her father in 1813, in which he acknowledged her as his legitimate daughter and bequeathed her all his property. She then began her remarkable litigation, first to establish her legitimacy, then to secure her father's estate. The Supreme Court of Louisiana pronounced her legitimate and his lawful heir in 1856. Subsequently, the United States Supreme Court decided that the facts of her father's secret marriage in Philadelphia and her own legitimacy were fully established. Then began the struggle to secure possession of the estate. She filed a bill in equity in the United States Supreme Court in 1856, and a favorable decision was rendered in 1867. In 1861 the property in New Orleans was valued at $35,000,000, and previous to 1874 she obtained $6,000,000. Appeals and counter-suits were in progress at the time of her death in 1885. She married W. W. Whitney in 1832 and at his death, Gen. Edmund P. Gaines in 1839.

GAINES' MILL, Battle of. After the battle of Mechanicsville or Beaver Dam Creek, 26 June 1862, McCall's division was withdrawn from the field of its victory and Gen. Fitz John Porter, with it and the Fifth corps, took up a defensive position near Gaines' Mill, east of Powhite Creek, a small stream flowing into the Chickahominy. Porter's corps and McCall's division, numbering in all about 20,000 infantry and artillery and 2,500 cavalry, were the only Union troops north of the Chickahominy, the rest of McClellan's army being south of it. Porter's line was formed in the shape of a semi-circle, its left resting in the low ground near the Chickahominy, with its right bending around south of Old Cold Harbor. The line was naturally strong and was strengthened by rifle-pits, by felling trees in front of them and by piling rails and such other material as was at hand. The east bank of the creek was quite high and the slope to the creek was covered with brush and timber. The line covered several of the bridges over the Chickahominy and through the centre and right ran the roads from New Cold Harbor and Old Cold Harbor to Dispatch Station. Sykes' division of the Fifth corps was on the right and Morell's division on the left, with McCall's division in reserve. General Cooke, with three small cavalry regiments, watched the left. The line was somewhat too extended for the number of troops Porter had at his disposal, but these were well posted and his artillery placed in good positions, sweeping the ground in front. On 27 June the Confederates advanced upon Porter's position, A. P. Hill and Longstreet from the west, Jackson and D. H. Hill from the northwest. A. P. Hill led the advance from Mechanicsville, and on reaching Powhite Creek, near Gaines' Mill, at noon, Gregg's South Carolina brigade was so stoutly resisted by the Ninth Massachusetts, holding an advanced position, that Hill was checked and compelled to deploy a large force to push the Massachusetts men back, which consumed the time until 2 P.M. Meanwhile the other divisions had come up, Longstreet on A. P. Hill's right, Jackson, Ewell and D. H. Hill in the order named, on A. P. Hill's left. The main battle began a little after 2 o'clock with an impetuous assault by A. P. Hill on Porter's left division and resulted in the final repulse of Hill with great loss. Longstreet came to his support, Jackson and D. H. Hill closed in on Porter's right and for nearly two hours Porter's entire line was successively assailed and pressed at every point, but held firm, so firm that General Lee thought that "the principal part of the Federal army was on the north side of the Chickahominy" and "apparently gaining ground." McCall's division was placed in line. All fought well and were admirably handled; but there were not enough of Porter's men long to withstand the energetic and continued pressure of 57,000 Confederates at all parts of the line. At about 4 P.M. Slocum's division of Franklin's corps came on the field from beyond the Chickahominy. Its three brigades were separated and disposed of in weak places on the line and the general attack was repulsed about 5 P.M. A few minutes later another attempt was repulsed, the Union line holding fast and not yielding a foot. The Confederate forces were now all up. Whiting's division had come to the relief of A. P. Hill; and Stuart, with his cavalry and artillery, opened heavily on Porter's right. General Lee now ordered a general advance, which was responded to in a most gallant manner. Porter's lines were fiercely assaulted; parts remained firm, but other parts gave way and soon all gave back, losing 22 guns and some 2,800 prisoners. Some of the commands fell back in much confusion; others retired in good order upon the brigades of French and Meagher, of Sumner's corps, which had crossed the Chickahominy, and now assisted in checking the Confederate pursuit. During the night the Union troops crossed to the south side of the Chickahominy, destroyed the bridges behind them and joined the rest of the army in its retreat to Harrison's Landing on James River. The entire number of Union troops engaged was about 34,000; the loss was 894 killed, 3,107 wounded and 2,836 missing, an aggregate of 6,837. The number of Confederate troops engaged was about 57,000, of whom 8,751 were killed and wounded.

Bibliography.— Alexander, 'Military Memoirs of a Confederate' (New York 1907); Johnson and Buel, 'The Battles and Leaders of the Civil War' (New York 1887); Nicolay and Hay, 'Abraham Lincoln; A History' (New York 1890); 'Official Records' (Vol. XI, Washington 1885); Ropes, 'The Story of the Civil War' (Vol. II, New York 1894–98); Steele, 'American Campaigns' (Washington 1909); Webb, 'The Peninsula' (New York 1881).

GAINESVILLE, Fla., city and county-seat of Alachua County, on the Seaboard Air Line, the Atlantic Coast Line and the Tampa and Jacksonville railroads, 70 miles southwest of Jacksonville. Owing to its temperate climate it is a favorite winter resort. Its industrial interests are chiefly agricultural; fruit growing, is largely carried on, and we mention also the phosphate mining, the foundries and planing mills. Pop. 6,737.

GAINESVILLE, Ga., city and county-seat of Hall County, on the Southern, the Gainesville Northwestern and the Gainesville Midland railroads, 53 miles northeast of Atlanta. From its situation at the summit of the Chattahoochee ridge, and owing to the numerous mineral springs in the vicinity, it is a much-frequented health resort. The educational establishments include Brenau College and Conservatory of Music, the Riverside Military Academy, etc. There are milling industries and manufactures of machinery and wagons, and the city owns its electric-lighting plant and waterworks. Pop. 5,925.

GAINESVILLE, Tex., city and county-seat of Cooke County, on the Missouri, K. and T., and the Gulf, C. and S. F. railroads, 65 miles north of Fort Worth. This is the centre of an important agricultural and stock-raising district. It has large meat-packing establishments and manufactures of flour, foodstuffs, cottonseed oil, carriage works, hide and leather factories and pressed-brick works. The town was first settled in 1851, and was incorporated in 1873. It is governed under a charter of 1879 by a mayor and council elected by popular vote every two years. The post office, city hall, library and city park are noteworthy. Pop. 7,624.

GAINSBOROUGH, gānz'bŭr-ō, **Thomas,** English painter: b. Sudbury, Suffolk, May 1727; d. London, 2 Aug. 1788. He was the son of a wool manufacturer, and was educated under his uncle in the grammar-school of his native town.

His artistic genius early displayed itself, and for a time he studied art in London under the French engraver Gravelot, and afterward under Frank Hayman. He married at 19, set up as a portrait painter in Ipswich, and in 1758 took up his residence in Bath, where he soon acquired a leading position as a portrait painter. He sent pictures to the exhibitions of the Society of Artists from 1761 to 1768, and in the latter year was elected one of the original members of the Royal Academy. He contributed to the Academy exhibitions during the period 1769–72, and again, after an interval of estrangement from Sir Joshua Reynolds, from 1777 till 1783. The pictures shown during the first of those periods comprised some landscapes and numerous portraits, among them those of Garrick (two), the Duke of Argyll and Lord Nugent. Owing to a quarrel with his friend and patron, Philip Thicknesse, he left Bath for London in 1774, and in the metropolis his fame rapidly increased. Among the pictures exhibited at the Academy after his arrival in London none is more celebrated than the 'Blue Boy' (1779), said to have been painted to refute a statement made by Sir Joshua Reynolds in one of his discourses. Among portraits painted during this period are those of the Duchess of Devonshire, Duchess of Cumberland, Duke of Argyll, General Conway, Sir Bate Dudley, George III and his queen, Bishop Hurd, the Prince of Wales, Colonel St. Leger, Lord Cornwallis, the Princess Royal and other members of the royal family. Owing to a quarrel about the hanging of some pictures, he never exhibited at the Academy after 1784. Before his death he was reconciled to Sir Joshua Reynolds. Among his other works the following should be mentioned: portraits of Mrs. Siddons, Hon. Mrs. Graham, Pitt, Blackstone, Johnson, Sterne, Richardson, Clive, Burke, Canning, Franklin, besides others; 'The Market Cart'; 'The Watering Place'; 'The Brook'; 'Rustic Children'; 'The Cottage Door'; 'Cows in a Meadow'; 'Gainsborough's Forest,' and other fine landscapes. Gainsborough painted in all 300 works, of which 220 were portraits, and he had 56 subjects on hand at the time of his death. Both in portraiture and in landscape he is in the first flight of English artists. Graceful, spirited, sure of touch, exquisite in his colorings, his subjects, who invariably look pleasant and often distinguished, epitomize the fashion and culture of the 18th century. In his landscapes he shows a partiality for pastoral scenes, for evening lights and cloudy skies. Many of his portraits have within recent years found a home in the United States. Among private collectors in New York, Mr. George J. Gould, Mr. E. H. Huntington and Mr. Henry C. Frick possess valuable specimens. The J. Pierpont Morgan collection in Metropolitan Museum of New York includes, among other portraits, 'Georgina, Duchess of Devonshire,' also known as the 'Stolen Duchess.' This was sold to Messrs. Agnew of London in 1876 for £10,605, and was immediately thereafter stolen, its fate remaining a mystery until it was returned in 1901 by the thieves from Chicago, because of their inability to dispose of it, when it was purchased by J. Pierpont Morgan. Consult 'Lives,' by Fulcher (1856); Brock-Arnold (1881); Bell (1897); Gower (1903); Fletcher (1904); Boulton (1905); Wedmore, 'Studies in English Art,' first series (1878); Armstrong, 'Gainsborough and His Place in English Art' (1898); Chamberlain, 'Gainsborough' (1903).

GAINSBOROUGH, England, an ancient town in Lincolnshire, on the Trent River, containing a timber-framed Old Moot Hall of the 15th century and other edifices of antiquarian interest and modern use. In George Eliot's novel, 'The Mill on the Floss,' this town is called Saint Ogg's. The trade by water, river and canals is great. To Americans this place is of interest because here gathered, before 1604, the congregation that became the Pilgrim Fathers (q.v.) of New England, some of the fathers of the Baptists in America, and some also identified with the earliest historic literature of the Western world. The leaders were John Smythe and John Robinson (q.v.), the former leading a party into the Dutch Republic in 1606 and the latter in 1608. On 29 June 1896, a large company of Americans, "New World Pilgrims to Old World Shrines," with the United States Ambassador, T. F. Bayard, who made the address of the day, visited Gainsborough to lay the cornerstone of the John Robinson Memorial Church and to celebrate the spiritual movement in Tudor times of "men who beyond their dark age led the van of thought," which meant "the emancipation of England from Norman domination." The church edifice has been in use since 1897. Consult 'The Book of the Pilgrimage' (Boston 1896).

GAIRDNER, gărd'nėr, **James,** English historian: b. Edinburgh, 22 March 1828; d. 4 Nov. 1912. When 18 years old he entered the Public Record office in London as a clerk, and was assistant keeper from 1859 to 1893. He distinguished himself by the rare combination of profound erudition, patient accuracy and judicial temper which he displayed in the editing of a long series of historical documents: 'Memorials of Henry VII' (1858); 'Letters and Papers Illustrative of the Reigns of Richard III and Henry VII' (1861–63), in the Rolls series; 'Calendar of Letters and Papers, Foreign and Domestic, of the Reign of Henry VIII' (11 vols., 1880–96); and 'Historical Collections of a London Citizen' (1876), and 'Three Fifteenth-Century Chronicles' (1880), for the Camden Society series; 'The English Church in the Sixteenth Century' (1902); 'Lollardy and the Reformation in England' (1908, 1911). Equally valuable are the books addressed to a wider audience: an edition of the 'Paston Letters' in Arber's series (1872–75); 'The Houses of Lancaster and York,' in 'Epochs of Modern History' (1874); 'Life and Reign of Richard III' (1878); 'England' in 'Early Chroniclers of Europe' (1879); 'Studies in English History' (1881), written in conjunction with Spedding; and 'Henry VII,' 'Statesmen' series (1889).

GAIRDNER, Sir **William Tennant,** Scottish pathologist: b. Edinburgh, 8 Nov. 1824; d. 28 June 1907. He was graduated M.D. at Edinburgh in 1845, and from 1862 until his retirement in 1890 occupied the chair of medicine in Glasgow University. Among his published books are 'Pathological Anatomy of Bronchitis and Diseases of the Lungs' (1850); 'Clinical Medicine' (1862); 'Public Health in Relation to Air and Water' (1862); 'Insanity: Modern Views as to its Nature and Treatment' (1885); 'The Physician as Naturalist' (1889).

GAISERIC, gī'sėr-ĭk. See GENSERIC.

GAISFORD, Thomas, English scholar and Greek philologist: b. at Ifort, Wiltshire, England, 22 Dec. 1779; d. 2 June 1855. He was educated at Christ Church, Oxford, took orders in the Church, and in 1811 was appointed regius professor of Greek in the University of Oxford. In 1831 he became dean of Christ Church, remaining such till his death, and in 1847 rector of Westwell and curator of the Bodleian Library. He was a prolific writer, his principal works being 'Hephæstronis Enchiridion de Metres' (Oxford 1810, Leipzig 1832); 'Poetæ Græci Minores' (1814–20, 4 vols.); 'Stobæi Florilegium' (1822, 4 vols.); 'Herodoti Historiæ' (1824); 'Sophoclis Tragædiæ' (Oxford 1826, 2 vols.; Leipzig 1827, 8 vols.); 'Suidæ Lexicon' (1834, 3 vols.); 'Parænuographi Græci' (1836); 'Scriptores Latini rei Metricæ' (1837); 'Entymologicum Magnum' (1848); and 'Eusebii Demonstratio Evangelica' (1852, 3 vols.). He was elected a member of the Institute of France, and in 1856 the Gaisford prize, for Greek composition, was founded at Oxford in his memory.

GAIUS, gā'yŭs, the name of several persons mentioned in history: (1) A Roman general, the son of Marcus Agrippa and Julia, daughter of Augustus Cæsar. He was adopted by Augustus and distinguished himself as a soldier during the 1st century B.C., having reduced Armenia and routed Tigranes. (2) A Roman jurist who lived 130 to 180 A.D. Before the revision of the Roman law and the reform of legal studies by Justinian, the 'Institutes' of Gaius, afterward the ground work of the 'Institutes' of Justinian, were the received textbooks of the schools of law. Almost completely lost until 1816, their discovery at Verona by Niebuhr threw a flood of light on the history of the early development of Roman law. (3) A Christian controversialist of the 3d century. He regarded the Epistle of Saint Paul to the Hebrews as apocryphal, and was the first who wrote against Cerinthus and the Millenarians. (4) GAIUS, SAINT, bishop of Rome, 283 to 296; d. 22 April 296. A native of Dalmatia and nephew of Diocletian, he suffered many hardships during the first persecution of the Christians by the emperor.

GALABAT, gä-lä-bät', or **KALABAT,** Africa, a small district situated near the western frontiers of Abyssinia contiguous with the Anglo-Egyptian Sudan. The people, some 20,000 in number, and fanatical Mohammedans, trade with Abyssinia in coffee, cotton, hides and beeswax. The district contains about 1,500 square miles. It was for a number of years within the Italian sphere of influence.

GALACTIC CIRCLE, the great circle of the heavens which coincides best with the course of the Galaxy or Milky Way. According to Sir John Herschel, the north pole of this great circle is situated approximately in right ascension 12 hours 47 minutes, and declination +27°, the circle crossing the equator at the points whose right ascensions are about 6 hours 47 minutes and 18 hours 47 minutes. See GALAXY.

GALAGO, ga-lā'gō, a genus of African lemurs (q.v.), arboreal and nocturnal in habit, living on fruit and insects. They vary from the size of a rabbit to that of a rat, are covered with soft fawn-gray woolly fur, have somewhat bushy tails longer than the body, and hind legs longer and stronger than the arms, with two of the ankle bones (*calcaneum* and *navicular*) greatly elongated. The head is round like a cat's; the eyes are large with oval pupils contracting in daylight to vertical slits; the ears are naked and very big, expanded during activity, but rolled together when the animal rests. The female is said to bear one young one at a birth, and often carries it about. Soft nests are also made in the branches. The Galago proper (*G. senegalensis*) seems to be distributed throughout tropical Africa, and is known in Senegal as "the gum animal" from its frequent habitat in mimosa or gum-acacia forests, and from its alleged habit of gum-chewing. It is said to be eaten there. The largest species (*G. crassicaudatus*) measures a foot in length, not including the bushy tail, which is 15 or 16 inches more. In Zanzibar the komba (*G. agisymbanus*) is said frequently to make itself intoxicated with palm-wine, so that it falls from the tree and gets caught. It is readily tamed and utilized to catch insects and mice in the houses. There are numerous species, and the Madagascar genera *Chirogale*, *Microcebus* and *Opolemur* are joined with it in the sub-family *Galaginæ*. Consult Beddard, 'Mammalia' (London 1902).

GALAHAD, SIR, son of Launcelot and Elaine and the noblest of the Knights of the Round Table, of whom he alone was successful in the search for the Holy Grail. He was introduced into the Grail legend by Walter Map (q.v.). (See GRAIL; ROUND TABLE, KNIGHTS OF). Consult Morley, 'English Writers' (Vol. III, London 1887–90).

GALANGAL, a dried rhizome obtained from different species of *Alpinia* growing in the East. What is known as the lesser galangal is brought from China. It occurs in small pieces, cylindrical and forked, striated and diversified with whitish rings; the outside is brown, the inside paler. It has an aromatic taste and odor, and is an agreeable substitute for ginger in dyspepsia. It yields an oil and a soft resin, but its chemical composition is not settled. The larger or Java galangal is coarser, and is not so strongly aromatic. The rhizome of *Alpinia officinarum* has been used in medicine as a stimulant aromatic.

GALANTHA, gä-lăn'thȧ, **Eszterhazy von,** Hungarian Magnates and, later, princes of the German empire. See ESTERHAZY VON GALANTHA.

GALANTHUS. See SNOWDROP.

GALAPAGOS, găl'-a-pä'gōs, **ARCHIPELAGO,** a group of volcanic islands in the Pacific Ocean, belonging to the Republic of Ecuador (q.v.). It consists of 15 larger islands and about 40 smaller, with a total area estimated at 2,400 to 3,000 square miles, and all included between lat. 0° 38′ N. and 1° 27′ S. and long. 89° 16′ 30″ W. and 91° 40′ 45″ W., except Culpeper and Wenman which lie somewhat farther toward the North. The more important in area are Albemarle, Indefatigable, Marlborough, Chatham, James and Charles — to give them the names in general use; at the same time we note that the government of Ecuador in 1892 renamed the archipelago, rather inappropriately, «Colón» and invented novel designations for separate members of the group. The distance from Chatham Island to Guayaquil is 620 miles, to Panama 840 miles, and to San Francisco 2,990 miles. Features of wholly exceptional interest in the natural history of the archipelago were noted by Charles Darwin in his journal of the voyage of the *Beagle*, which forms the basis of the present description. The constitution of the whole is volcanic; with the exception of some ejected fragments of granite every part consists of lava, or of sandstone resulting from the attrition of such materials. The higher islands (which attain an elevation of 3,000 to 4,000 feet) generally have one or more principal craters toward their centre, and on their flanks smaller orifices. There are, in all the islands, at least 2,000 craters. Though the islands are placed directly under the equator, climate is not in all parts of them excessively hot; a circumstance which is owing to the singularly low temperature of the surrounding ocean (compare the observations mentioned below). Very little rain falls, except during one short season, but the clouds generally hang low; therefore the summits, at an elevation of 1,000 feet or more, possess a tolerably luxuriant vegetation, while the lower parts of the islands are extremely arid. On a part of Chatham Island, black cones, the former chimneys of the subterranean heated fluids, are so numerous and in form so regular that they give the country a «workshop» appearance, which strongly reminded Mr. Darwin of the great iron foundries of Staffordshire. All the craters on Chatham are extinct, but on the western islands «the volcanic forces were in frequent activity.» Charles Island was frequented by buccaneers and whalers long before Ecuador established a small penal colony there. The soil of the elevated portions of that island is fertile black mud; the climate of the same regions is tempered by a cool southerly tradewind; and wild pigs and goats are found in the woods, «but the main article of animal food is derived from the tortoises»— which sometimes weigh 200 pounds each. On both Albemarle and Marlborough islands, eruptions occasionally take place. Of the former, Mr. Darwin writes: «I should think it would be difficult to find in any other part of the world an island situated within the tropics, and of such considerable size (namely, 75 miles long), so sterile and incapable of supporting life.» On James Island there is a lake from which salt is procured. The equatorial heat was observed in its effect upon the soil of the lower and sterile parts.. There the thermometer placed in sand of a brown color immediately rose to 137°, and black sand was so much hotter that it was disagreeable to walk over, even in thick boots. An acacia, a cactus, and one of the euphorbiaceæ — a bush with minute brown leaves — are common in some parts of these lowlands. Near the summits the vegetation has a very different character; ferns and coarse grasses are abundant; and the commonest tree is one of the Compositæ. There are no members of the palm family. «The natural history of this archipelago,» Mr. Darwin says, «is very remarkable. It seems to be a little world within itself; the greater number of its inhabitants, both vegetable and animal, being found nowhere else.» And again, «In my collections from these islands there are 26 different species of landbirds. With the exception of one, all probably are undescribed kinds, which inhabit this archipelago and no other part of the world.» The order of reptiles forms the most striking feature in the zoology of the islands, the species not being numerous, but the number of individuals of each kind extraordinarily great. There is one kind both of the turtle and tortoise; of lizards four; and of snakes about the same number. Of the tortoise (*Testudo Indicus*) some old males have been found so large that it required six or eight men to lift them from the ground. Mr. Darwin says: «I frequently got on their backs, and then, upon giving a few raps on the hinder part of the shell, they would rise up and walk away; but I found it very difficult to keep my balance. The tortoise is very fond of water, drinking large quantities, and wallowing in the mud. The larger islands alone possess springs, and these are always situated toward the central parts, and at a considerable elevation. The tortoises, therefore, which frequent the lower districts, when thirsty, are obliged to travel from a long distance. Hence broad and well-beaten paths radiate off from the wells even down to the seacoast. Near the springs it was a curious spectacle to behold many of these great monsters; one set eagerly traveling onward with outstretched necks, and another set returning, after having drunk their fill.» Mr. Darwin inclined to the opinion that the Galápagos islands are the original home of the *Testudo Indicus*, though it is now found in many parts of the world. Also characteristic of this archipelago are the lizards, individuals of the aquatic variety being three or four feet long. Many of the islands possess trees, plants and birds, which do not occur on the others. At the date of Mr. Darwin's visit the birds had not learned to fear man. He wrote: «A gun is here almost superfluous; for with the muzzle of one I pushed a hawk off the branch of a tree.» The *Pan American Union Bulletin*, Vol. XXXII (Jan.-June 1911), pp. 222 *seq.*, states that in 1814 and 1825 English skippers reported activity in the Galápagos craters, and as late as 1907 a new opening appeared on James Island from which a torrent of lava flowed to the sea. The Eucadorian government took possession of the group 12 Feb. 1832, and it seems that the act of occupation was suggested by a citizen of the State of Louisiana, Mr. Villamil, who obtained a concession from Ecuador and was governor of the islands at the time of Darwin's visit. The average temperature is about 72° F. The mitigating influence of the Humboldt current is mentioned in the article LATIN AMERICA — *climate*. But remarkable differences of temperature are observed: for example, on one side of Albemarle Island a foot below the surface the ocean's temperature was 80° F., while on the other side it was less than 60° F. The number of indigenous botanical species is now given at 190; and there are 58 distinct species of land birds.

MARRION WILCOX.

GALATA, gä'lä-tä, a suburb of Constantinople (q.v.).

GALATEA, găl-a-tē'a, (1) In Greek mythology, daughter of Nereus and Doris. The Cyclops Polyphemus persecuted with his love this charming nymph, though he gained nothing but ridicule in return. The handsome shepherd Acis, of Sicily, enjoyed her affection, and suffered death on her account; for Polyphemus, finding them together, and mad with jealousy, hurled a rock at them, which dashed Acis in pieces, while Galatea escaped into the sea. Acis was transformed into a fountain, and hastened to meet his mistress in a safer region. Other legends have Galatea the mother of Galas by Polyphemus. Poets and sculptors both ancient and modern have derived much inspiration from the myth. In English literature it has been used by Gay 'Acis and Galatea,' by Proctor in 'Death of Acis,' by Buchanan in 'Polypheme's Passion' and by Austin Dobson in 'Tale of Polypheme.' (2) A sheperdess in Virgil's 'Third Eclogue' who throws an apple to her lover, and flees, taking care to be seen, hence a type of the coquette. (3) A statue endowed with life by Venus at the prayer of Pygmalion.

GALATIA, gă-lā'shĭ-a, Asia Minor, the ancient name of an extensive region, so called from its Gallic inhabitants, who were immigrants from Europe. With the Gauls were intermingled a considerable proportion of Greeks; hence the inhabitants were often called Gallogræci, as well as Galatians. The Apostle Paul visited Galatia twice and addressed the 'Epistle to the Galatians' to the churches of Antioch in Pisidia of Lystra and other places.

GALATIANS, Epistle of Paul to the. The Apostle Paul wrote this letter to the churches of Galatia (i, 2) in order to counteract the influence of an extreme type of Judaistic christianity which, he was convinced, was threatening to undermine faith in Christ alone as the fundamental principle of the Gospel and which appears to have gained a strong footing in those churches which he himself had founded. Apparently, the Judaizers had attacked not only Paul's doctrine but also had insinuated that he was not really an apostle and therefore his teaching had no apostolic authority.

The news of the defection of his Galatian churches came to Paul as a great surprise (i, 6) and filled him with grief and indignation. He wrote immediately and his letter is intense, even severe, written hastily perhaps, but not thoughtlessly or carelessly.

He first sought to show that both his apostleship and the gospel he preached were of divine, not human authority. He had been called to his apostolic work directly by God and to no man did he owe his knowledge of the gospel (i, 6–24). Nevertheless, both he and the gospel as he preached it had been fully recognized and approved by the leaders of the mother church in Jerusalem (ii, 1–10), and on one occasion he had even rebuked Peter for inconsistency and disloyalty to the truth of the gospel when he weakly yielded to the Judaizing extremists (ii, 11–21). He then asked the Galatians to recall their own past experience as evidencing that "faith," and not "Works of the Law," is the condition of the Spirit's presence and power (iii, 1–6). He next showed that the principle of "faith" antedated and is superior to that of the Law even in the Old Testament. The Law is only of a secondary and temporary significance entailing bondage; it was simply preparatory to the dispensation of faith which alone brings liberty and sonship (iii, 7–v, 12). After a few hints as to the true character of christian conduct (v, 13–vi, 10) the letter closes with a final warning against trusting to circumcision in preference to faith in the crucified One (vi, 11–16).

The purpose of the letter is thus perfectly clear from its contents and no reasonable doubt can exist as to its authorship by Paul. In importance Galatians is second to no other of Paul's epistles. Its biographical material in chaps. i and ii is invaluable, while in its statement and exposition of Paul's great doctrine of justification by faith this epistle, along with Romans, has been the great source from which theologians from Augustine to Luther and Calvin have drawn their arguments.

The critical questions regarding Galatians are mainly two, as to its destination and date.

Who were the "Galatians" (iii, 1) and where were "the churches of Galatia" (i, 2) to whom Paul addressed this remarkable letter? The traditional view (now commonly called the *North Galatian* theory) is that the Galatians addressed lived in old Galatia proper, a large district in the interior of Asia Minor, north of Lycaonia and east and northeast of Phrygia (the boundaries of which were rather vague). A more modern and widely accepted view is that by "Galatia" in (i, 2) is meant the recently organized Roman Province of Galatia (which included old Galatia and parts of Phrygia, Lycaonia, etc.) and that the "churches of Galatia" were those founded by Paul and Barnabas on the first missionary journey (Acts xiii and xiv), i.e., Antioch of Pisidia, Iconium, Lystra and Derbe. For the traditional view it is claimed that it is based on the simpler and more natural interpretation of the terms "Galatia" and "Galatians," and that Acts (xvi, 6 and xviii, 23) imply, or at least allow for, missionary work by Paul in old Galatia. For the other, or *South-Galatian* theory, it is claimed that these passages do not imply any missionary work in old Galatia, but on the contrary refer to the western part of the Province of Galatia traversed by Paul on his first and second journeys. In favor of this theory it is urged that churches so important must certainly have been mentioned by Luke in Acts and therefore they are the ones whose founding is told in Acts xiii and xiv. But since Luke omitted many important details of Paul's missionary work, which are referred to or implied in his epistles, this argument has little force.

As to the date of the epistle it is evident from i, 18–ii, 1, that it was written *after* more than about 15–17 years had passed since Paul's conversion. And since about 33 A.D. is the earliest possible date for the latter event, Galatians could not have been written before 49 or 50 A.D. In other words, the visit to Jerusalem, mentioned in ii, 1–10, which took place 3+14 years (=about 15–17 years) after Paul's conversion, must have been made about 49 or 50 A.D., and as the way Paul refers to it implies that it had transpired a considerable time before he wrote, the probable date of the epistle would be some years after 50 A.D. Incidentally, these considerations seem fatal to the identification of the visit to Jerusalem of Gal. ii, 1–10 with that mentioned in Acts xi, 27–30 (advocated by many who adopt the South Galatian view) instead of the traditional identification of Gal. ii, 1–10 with Acts xv, since the former visit took place, apparently near the time of the death of Herod Agrippa, 44 A.D. (cf. Acts xii). In spite of differences between Acts xv and Galatians ii, 1–10, these two must be interpreted as referring to the same occasion, and Luke's account must be adjusted to Paul's. The advocates of the South Galatian theory are not at all unanimous as to the date of the epistle. Some (e.g., Luke) would date it even before the council of Acts xv; while others would put it later. On the North Galatian view the epistle would be dated after the time of Acts xviii, 23, especially if the expression τὸ πρότερον (Gal. iv, 13) is taken strictly as meaning the *former* (of two visits). On the whole a date in the latter part of the period covered by Paul's third journey, either during the last months of his stay at Ephesus (54 A.D.) or while he was *en route* from Ephesus to Corinth (early in 55) seems most satisfactory. In this way the close resemblance between Galatians and Romans is best accounted for, the Galatian defection having brought forcibly to Paul's mind the danger to the Church in the Judaizing propaganda, and his hurried argument in the epistle to the Galatians being more deliberately worked out in Romans which was written soon after, while he was resting at Corinth (spring of 55 A.D.).

Bibliography.— The literature on Galatians is extraordinarily voluminous, and for a full bibliography one may consult Moffatt, 'Introduction to the Literature of the New Testament' (New York 1915). Monographs of especial value are Lagrange, M. J., 'Les Judaisants de l'Epitre aux Galatea' (in *Revue Biblique*, 1917, pp. 129–167); Lake, K., 'The Earlier Epistles of Paul' (London 1911); Lightfoot, 'Saint Paul's Epistle to the Galatians' (11th ed., 1892); Steinmann, 'Abfassungszeit des Galaterbriefes' (Munster 1906), and 'Der Leserkreis des Galaterbriefes' (Ibid 1908); Watkins, C. H., 'Saint Paul's Fight for Galatia' (Boston 1914).

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GALAX, a genus of plants of the family *Galacaceæ*, containing a single species, *G. aphylla*, occurring from Virginia to Georgia, chiefly in the mountains. The plant is a perennial, with a basal cluster of leaves and slender simple flowering stems terminating in slender spikes of small greenish flowers. The leaves are rounded, heart-shaped, somewhat leathery and shining. In autumn they assume a beautiful bronze color and then, as well as at other times, they are gathered in large quantities to be used for decorative purposes, especially for wreaths and for Christmas greens.

GALBA, Servius Sulpicius, Roman emperor: b. 3 B.C.; d. 15 Jan. 69 A.D. Caligula appointed him general in Germany. He soon repulsed the Germans who had invaded Gaul, and restored the ancient military discipline. After the death of Caligula he caused his troops to swear allegiance to Claudius, who sent him in 45 A.D. as proconsul to Africa, where great confusion prevailed. In two years Galba restored order, obtained the honors of a triumph, and was received among the priests of Augustus. Nero appointed him in 61 A.D. governor of Hispania Tarraconensis, but soon after became so exasperated against him that he ordered him to be secretly assassinated. Galba then revolted, but when news arrived of the insurrection among the prætorians at Rome, and of the death of Nero, 68 A.D., he himself was chosen emperor by the prætorian cohorts in Rome. Ambassadors from the senate made known to him his elevation. He chose a colleague in the government under the name of an adopted son, but instead of Otho, favored by the soldiery, he selected Piso Licinianus, hated by them on account of his rigid virtue. Otho, offended by this neglect, resolved to get possession of the throne by force of arms. The prætorian cohorts first declared themselves in his favor, and Galba, attempting in vain to restore order, was attacked and slain.

GALBANUM, a gum-resin obtained from *Ferula galbaniflua* and allied plants, used in medicine as a carminative and expectorant, and externally as an irritant.

GALBRAITH, John, Canadian engineer: b. Montreal 1846; d. 1914. He received his education at the University of Toronto, studied engineering and surveying and was engaged on the construction of the Intercolonial Midland and Canadian Pacific railroads. He led an exploring expedition in 1880 from Georgian Bay to Fort Churchill and Lake Mistassini. In 1878 he was appointed professor of civil engineering in the newly-founded school of practical science at Toronto, and in 1889 was made director of the institution. He was one of the original founders of the Canadian Society of Civil Engineers; was an associate of the English Institute of Civil Engineers. In 1907 he was appointed on a royal commission to report on the causes of the collapse of the great railroad bridge over the Saint Lawrence at Quebec.

GALDÓS, Benito Pérez, a noted Spanish writer born in 1840. See PÉREZ GALDÓS, BENITO.

GALE, Henry Gordon, American physicist: b. Aurora, Ill., 12 Sept. 1874. In 1896 he was graduated at the University of Chicago; began his connection with the department of physics there in 1899, and in 1911 became associate professor. He was physicist of the Solar Observatory at Mount Wilson, Cal., in 1906 and in 1909–11 was research associate there for the Carnegie Foundation. With R. A. Milliken he wrote 'A First Course in Physics' (1906); 'A Laboratory Course in Physics' (1906); with Adam, W. S., 'An Investigation of the Spectra of Iron and Titanium under Moderate Pressures' (1912).

GALE, James S., American missionary, editor and lexicographer in Korea, who has done more than any other writer to open the treasures of the language and literature of the Koreans. Commissioned by the Presbyterian Church, he arrived in the peninsula in 1889. In collaboration with H. G. Appenzeller and H. G. Underwood, the noted pioneers, he worked for many years upon the translation of the holy scriptures. His great dictionary of the Korean language, published in 1898, supersedes all others. He is also the author of 'The Vanguard,' a novel of early missionary life in

Korea; 'Korea in Transition' (1909); and of a great variety of learned articles on Korean history, literature and antiquities and on life and manners published in *The Korean Repository* (1892–98); *The Korean Review* (1901–06); *The Korean Magazine* (1917). Consult Griffis, 'A Modern Pioneer in Korea: H. G. Appenzeller' (1912).

GALE, Norman Rowland, English poet: b. Kew, Surrey, 1862. He received his education at Exeter College, Oxford. His 'Country Muse' appeared in 1892 and attracted general attention. A second series appeared within the same year. Other publications are 'Orchard Songs' (1893); 'A June Pastoral' (1894); 'Songs for Little People' (1896); 'Barty's Star' (1903); 'More Cricket Songs (1905); 'Song in September' (1912); 'Solitude' (1913); 'Collected Poems' (1914).

GALE, Zona, American author: b. Portage, Wis., 26 Aug. 1874. In 1895 she was graduated at the University of Wisconsin; was employed on the staffs of Milwaukee journals until 1901 and from 1901 to 1904 was on the staff of the New York *World* and also contributed to other journals. She has published 'Romance Island' (1906); 'The Love of Pelleas and Etarre' (1907); 'Friendship Village' (1908); 'Friendship Village Love Stories' (1909); 'Mothers to Men' (1911); 'Christmas' (1912); 'When I was a Little Girl' (1913); 'Neighborhood Stories' (1914); 'Hearts' Kindred' (1915); 'A Daughter of Tomorrow' (1917); and a one-act play, 'The Neighbors.'

GALE, a tree. See CANDLEBERRY.

GALEN, or **CLAUDIUS GALENUS,** Greek physician: b. Pergamus, Mysia, 131 A.D.; d. Sicily, about 201 A.D. He began the study of medicine at Pergamus, and afterward studied at Smyrna, Corinth and Alexandria. On his return to his native city in 158 he was appointed physician to the school of gladiators. Six years later he went to Rome, where he stayed four years, and gained wide reputation. Scarcely had he returned to his native city when he received a summons from the emperors M. Aurelius and L. Verus to attend them in the Venetian territory, and shortly afterward he accompanied them to Rome. There he remained several years, though how long is not known precisely, and about the end of the 2d century was employed by the Emperor Severus. Galen was a voluminous writer not only on medical, but also on philosophical subjects, such as logic, ethics and grammar. The works that are still extant under his name consist of 83 treatises, acknowledged to be genuine; 19 whose genuineness has been questioned; 45 undoubtedly spurious; 19 fragments; and 15 commentaries on different works of Hippocrates. His most important anatomical and physiological works are: 'Of Anatomical Administrations' and 'Of the Use of the Parts of the Human Body.' As an anatomist, he combined with patient skill and sober observation as a practical dissector — of lower animals, not of the human body — accuracy of description and clearness of exposition as a writer. He gathered up all the medical knowledge of his time and fixed it on such a firm foundation of truth that it continued to be, as he left it, the authoritative account of the science for centuries. His physiology does not, according to modern ideas, attain the same level of scientific excellence as his anatomy. He seems to place a more implicit faith in amulets than in medicine, and he is supposed by Cullen to be the originator of the anodyne necklace which was so long famous in England. His practice was based on the two general principles: (1) that disease is contrary to nature and is to be overcome by something that is contrary to the disease itself; and (2) that nature is to be preserved by that which has relation to nature. In the 9th century Galen's works were translated into Arabic and were in great vogue for centuries throughout the East. The Greek text has been issued four times; the Aldine (5 folio vols., 1525) was the first; the best and most complete modern edition is that by Kuhn (20 vols., 1821–33). Several minor works were issued by Helmrich and Müller (3 vols., Leipzig 1893) and there are several German and French translations of the more important treatises. Consult Daremberg, 'Exposition des connaissances de Galien sur l'anatomie' (Paris 184); Kidd, 'Transactions of the Provincial Medical Association' (Vol. VI, London 1831) and *Rhenisches Museum für Philologie* for the years 1889, 1892, 1896.

GALENA, Ill., city and county-seat of Jo Daviess County, a port of entry on the Galena River, and on the Illinois Central; Chicago, Burlington and Quincy and the Chicago and Northwestern railroads, 17 miles from Dubuque. Galena is famous as the home of Gen. U. S. Grant from May 1860 until the opening of the Civil War, and the old Grant homestead still remains one of the attractions of the city. Grant Park, a fine statue of General Grant, a government building, a public library, an excellent school system and a number of fine churches are evidences of public interest. A fine white stone building, formerly the custom house, is now used as a post office. In an upper room of this building is the famous painting, by Thomas Nast, representing the surrender of Gen. Robert E. Lee to Gen. U. S. Grant at Appomattox. The city has an extensive trade by rail and river, and is the centre of large lead and zinc mining interests. There are also smelting works, shoe factories, brick yards, marble, granite, cement works, iron-bridge works, furniture and cigar factories. The town, which was named after the galena ore found in the vicinity, was settled in 1827 and incorporated as a city in 1839. The mayor and council are elected every two years. The city owns its electric-light plant which supplies power to industries and towns in the vicinity, and has an artesian water system. Pop. 6,000.

GALENA, Kan., a city in Cherokee County, on the Missouri, Kansas and Texas and the Saint Louis and San Francisco railroads; seven miles west of Joplin, Mo. Like its namesake in Illinois, Galena is engaged largely in lead and zinc mining and smelting. The mining district, about four miles square, has 200 concentrating mills, and gives employment to 3,000 men. Among the industrial establishments are lead smelters, a large foundry, and a planing mill. There is a supply of natural gas in the neighborhood which furnishes heat and power at very low cost. It has paved streets, electric lights and sewers, and is situated in a prosperous farming and dairying centre. Over

$2,000,000 in ore was mined in 1915. The mayor and council are elected every two years. The deputy marshal and police are appointed by the council. Galena was settled and incorporated in 1877, and its population rapidly increased from 1,463 in 1880 to 8,000 in 1915.

GALENA, a sulphide of lead (PbS), containing when pure 86.6 per cent lead. It crystallizes in the isometric system, commonly in cubes or cubo-octahedrons, but is often found massive with a well-marked and characteristic cubic cleavage. It has a metallic lustre and lead-gray color. Its hardness is 2.5 and its specific gravity 7.5. Galena is the most important ore of lead, nearly all the world's supply of that metal being obtained from it. As it is always more or less argentiferous the mineral is frequently an important silver ore, the amount of silver present sometimes amounting to over 1 per cent, but galena containing less than 1 per cent silver is often mined as a lead-silver ore. The mineral is widely distributed, frequently being associated with the sulphides of iron, copper or zinc, and often with native gold. The principal mines working deposits of galena in the United States are in Missouri, Colorado, Idaho, Utah and Montana. See LEAD; SILVER.

GALENISTS, gā'lĕn-ĭsts, a religious sect founded by Galen or Galenus Abrahans de Haan. They were a branch of the Mennonites. Galen was a doctor of medicine and a minister among the Mennonites at Amsterdam. He taught freer doctrine in practice and belief than his co-religionists, declaring that the Christian religion was not so much a body of truths to be believed as of principles to be obeyed. His enemies accused him of having Socinian proclivities, a charge from which the States-General acquitted him 14 Sept. 1663. See MENNONITES.

The term was also in medical controversy during the Renaissance to mean a follower of Galen, whose authority as a physician they maintained against the introduction of new chemical methods into the preparation of medicinal drugs. The new school professed to extract essences, or quintessences, and, like modern homœopathists, gave doses small in bulk, but alleged to be powerful in effect, as containing a concentrated preparation of the original drug. The Galenists adhered to the ancient tinctures and extracts, which, they maintained, possessed all the virtues necessary.

GALEOTO, The Great. See EL GRAN GALEOTO.

GALERITES, găl-ę-rī'tēz, a genus of fossil sea-urchins, peculiar to and abundant in the Cretaceous system. The body in breadth is nearly circular or polygonal. The under surface is entirely flat, and has the mouth placed in its centre, with the vent near the margin. There are five avenues of pores reaching from the mouth to the summit of the conical dorsal surface. These fossils are often found silicified. *G. albogalerus* is one of the most abundant; it has received its specific name from its resemblance to the white caps worn by the priests of Jupiter.

GALERIUS, gă-lē'rĭ-ŭs, or **GALERIUS VALERIUS MAXIMIANUS,** Roman emperor: b. near Sardica, Dacia; d. 311 A.D. Entering the imperial army, he rose rapidly to the highest ranks. In 292 Diocletian conferred on him the title of Cæsar, made him administrator of Gaul, Spain and Mauretania, and gave him his daughter in marriage. In 295 he was victorious over the Carpi and Bastarnæ. In 297 and 298 he carried on an ultimately successful war against Persia. In 302 he urged Diocletian to suppress the increasing power of the Christian hierarchy. On the abdication of Diocletian (305) he and Constantius Chlorus became joint rulers of the Roman Empire, Galerius taking the east half. When Constantius died in York (306) the troops in Britain and Gaul immediately transferred their allegiance to his son, Constantine (afterward Constantine the Great), who was not recognized by Galerius till 308. Galerius, however, retained possession of the East till his death.

GALES, Joseph, American journalist: b. Eckington, England, 10 April 1786; d. Washington, D. C., 21 July 1860. He came to the United States with his father in 1793, was educated at the University of North Carolina and learned the printer's trade of his father. In 1807 he was made assistant and later partner of Samuel Harrison Smith in the management of the *Independent Gazetteer,* which had been removed to Washington and its name changed to the *National Intelligencer.* He became sole editor of that paper in 1810, and took his brother-in-law, William Winston Seaton, into partnership in 1812. Had it not been for the industry of Gales and Seaton an important part of the proceedings of the Senate and House of Representatives, which they reported, would not have been preserved. Especially is this true of the great debate between Hayne and Webster.

GALESBURG, Ill., a city and county-seat of Knox County, on the Atchison, Topeka and Santa Fé; the Chicago, Burlington and Quincy, and Chicago and Northwestern railroads, 43 miles northeast of Burlington, Ia. This is the seat of Knox College, founded in 1837, where took place the famous Lincoln-Douglass debate in 1859. Lombard University (Universalist) was established here in 1852, and the Saint Joseph Academy and the Ryder Divinity School are also located here. There is a public library containing 24,000 volumes. The Burlington railroad shops give employment to many mechanics, and there are extensive stock-yards, brick-making plants, boiler and engine works, farm machinery works and carriage factories. The census bureau's summary for 1914 is as follows: Number of industrial establishments, 60; persons engaged in manufactures, 1,709; proprietors and firm members, 47; salaried employees, 263; wage-earners, 1,399; primary horsepower, 1,984; capital, $2,488,000; services, $1,204,000; salaries, $263,000; wages, $941,000; materials, $1,515,000; value of products, $3,192,000. Under a general State law, passed in 1872, the mayor and city council are elected every two years, and the smaller offices are filled by appointments made by the mayor with consent of the council. The town was settled in 1837 by pioneers from New York State and named in honor of Rev. George W. Gale, who planned to establish a theological seminary here. During the Kansas-Nebraska struggle Galesburg was a rendezvous and rallying point for the free-soilers. The city was chartered in 1857. The municipality owns and operates its electric light and water plants. Pop.

(1910) 22,809; census bureau's estimate 24,276 on 1 July 1914.

GALETON, Pa., borough of Potter County, on Pine Creek, the Buffalo and Susquehanna railroad, 50 miles southeast of Bradford. Its industries are numerous and thriving; they comprise stave and wagon mills, a tannery, stove works, breweries, machine shops, railroad repair shops, knitting mills and lumber dressing mills. Pop. 4,100.

GALI, gä'lē, **Francisco,** Spanish navigator: b. Seville 1539; d. Mexico City 1591. He sailed from Acapulco in 1585 with two vessels, under commission of Pedro Moya de Contreras, provisional viceroy of New Spain, to look for a harbor on the coast of California where ships returning from the East Indies might be restocked with provisions. He visited the Philippines, Macao, the Lin-Kins, Japan and other islands, and on his return (1584) discovered what is now the Bay of San Francisco. The report of the voyage sent by him to the viceroy of the Indies was published by Linschot in a Dutch rendering in 'Track Charts of the Indies' (1596), and an English translation appears in Hakluyt's 'Voyages.' In the National Library, Mexico, are fragments of what is believed to have been a more extended narrative by Gali under the title of 'Viaje, discubrimientos y observaciones de Acapulco a Filipinas.' He was a skilful navigator and acute observer.

GALICIA, gă-lĭsh'ĭ-ą, Austria, a crownland or province of Austria, composed of the kingdoms of Galicia and Lodomeria, the duchies of Auschwitz and Zator and the grandduchy of Cracow, and formerly including the duchy of Bukowina. It is bounded on the north, northeast and east by Russia, southeast by Bukowina, south by Hungary and west by Moravia and a small portion of Prussian Silesia; area, 30,311 square miles; pop. 8,025,675 in 1910, and at the outbreak of the war about 8,200,000. The physical features of the country are determined by the Carpathians, which form a long and irregular curve on the south, the convexity being toward Galicia. Farther north the hills subside and merge into vast plains. The chief river in the northwest is the Vistula, which partly bounds the province. The Western Bug, a tributary of the Vistula, is partly in Galicia. The chief river is the Dniester. The only part of the surface belonging to the basin of the Danube is in the southeast. It is drained by the Pruth and is of limited extent. The climate is severe, particularly in the south, where more than one of the Carpathian summits are beyond the limit of perpetual snow. While Galicia is open to the cold north and east winds, these mountains intercept the warm winds from the south. The winters are long and rigorous and the summers very warm but comparatively short.

The soil is much diversified. In the more mountainous districts scanty pasture only is obtained, but in general, where the elevation is small, the ground, more especially where resting on a substratum of limestone, is of great fertility, and yields abundant crops of wheat, rye, barley, oats and maize. Hemp, flax and tobacco are also extensively grown, and the sugar beet is cultivated. The domestic animals include great numbers of horned cattle, generally of a superior description, and a fine, hardy breed of horses, well adapted for cavalry. Sheep are neglected; but goats, swine and poultry abound. The rearing of bees yields great quantities of wax and honey and is a lucrative industry. Bears and wolves are frequently met with in the forests, and all the lesser kinds of game are in abundance. The minerals include marble, alabaster, copper, lead, zinc, calamine, coal, iron and rock-salt. Only the last two are of much importance. Iron occurs in numerous parts of the central Carpathian chain and bog-iron ore is frequently met with in extensive seams on the plains. They are both worked to a considerable extent. Rock-salt is particularly abundant, stretching in continuous beds for nearly 250 miles along the base of the Carpathians, and of course beyond the limits of Galicia, into Bukowina and Transylvania. The most important mines have their central locality at Wieliczka. Manufactures have not made much progress. The spinning and weaving of flax and hemp prevail to a considerable extent on the confines of Silesia. Distilleries exist in every quarter. Tobacco, sugar, leather, beer, agricultural machinery, etc., are also manufactured. The principal exports are salt, wood, grain, coal, aniseed, linen and spirits. The population is generally of Slavonian origin and consists of two principal branches — Polish in the west and Russniak in the east. In religion they are divided among Roman Catholics, Greek Catholics and Armenians. The number of the Jews is considerable. The court of third instance for the country is the Superior Court at Vienna; there are two courts of second instance, one at Lemberg and the other at Cracow; and there are various district courts of first instance. The government has its headquarters at Lemberg. Educational establishments, both for superior and ordinary instruction, are numerous. At the head of the former stand the University of Cracow, with about 130 instructors and some 1,300 students, and the younger University of Lemberg, with 80 instructors and a similar attendance. The principal towns are Lemberg, the capital, Brody, Cracow, Stanislau, Tarnopol, Przemysl, Sambor, etc.

The nucleus of the modern kingdom of Galicia and Lodomeria was formed by the duchies of Halicz and Vladimir (the original forms of the present names), which were established about the beginning of the 12th century under two princes of the Russian dynasty of Rurik.

After being the field of continuous strife between Russians, Poles and Hungarians, Galicia continued a Polish dependency from 1382 till the first partition of Poland, in 1772, when it was acquired by Austria and became one of the Cis-Leithan provinces of the Austrian Empire, represented in the Reichsrat by 63 deputies, while the affairs peculiar to itself were deliberated and determined on by its own Landtag or Diet. Polish is the language of official intercourse and of the higher educational institutions. During the war in Europe, Galicia was for a long time an arena in which the Allies and the Central Powers struggled for supremacy. See WAR, EUROPEAN.

GALICIA, Sp. gä-lē'thē-a, Spain, an ancient kingdom and province, bounded north and west by the Atlantic, south by Portugal and east by León and Asturias, with an area of 11,256 square miles. It has been divided since 1833 into the minor provinces of Coruña, Lugo, Orense and Pontevedra, whose joint population is about 2,109,000. The country is mountainous, being traversed by offsets of the Asturian chain, rising in their highest peaks to about 6,500 feet. The west spurs, Capes Ortegal and Finisterre, project into the Atlantic. The numerous short but rapid rivers form small estuaries which afford secure havens and roads. The principal river is the Minho, which, with its feeder, the Sil, is navigable for small vessels on its lower course. Galicia has a mild, damp climate, favoring the development of a sturdy race devoted to agricultural pursuits; capital, however, is scarce, roads are bad and railways are few. Rich meadows and dense forests occur everywhere, but the soil is more suited to the cultivation of garden produce than of corn. Mines of lead, tin, copper and iron pyrites are worked. The inhabitants, called Gallegos, are robust, vigorous, industrious and, in comparison with the Spaniards of the southern and central parts of the peninsula, heavy witted and unpolished. Great numbers of them annually visit central and southern Spain and Portugal, where they find employment as harvesters, water carriers, porters, etc., and laboring men from this region seek employment in many parts of Latin America. Chief exports, live cattle, preserved meat, eggs, minerals, fish, fruits and grain; imports, coal, oil, hides, spirits, sugar and tobacco. The principal towns are Santiago di Compostella and the seaports Vigo, Coruña and Ferrol. Galicia was a kingdom under the Suevi from 411 to 585, and again for a few years after the death of Ferdinand the Great, in 1065, was an independent kingdom under his son Garcia for a few years. In the main, however, its fortunes were united with those of Castile.

GALILEAN, one of the followers of Judas the Gaulonite, who resisted the payment of the tax imposed by Quirinius, the Cyrenius of Saint Luke (Luke ii, 1), and gave the Romans trouble till the capture of Jerusalem by Titus in 70 A.D. Galilean is a name applied to Jesus and his disciples, from the intimate connection they had with Galilee (Matt. xxvi, 69; Mark xiv, 70); hence applied by pagans and Mohammedans as a term of reproach to Christians generally.

GALILEE, Palestine, during the Roman period and at the commencement of the Christian era a province comprehending the northern part of Palestine west of the Jordan. In pre-Roman times it was referred to as a district inhabited by the tribe of Naphtali.. Its name is derived from the Hebrew *galil,* signifying a circle or circuit. It now forms part of the pashalic of Damascus, in the Turkish province of Syria. Anciently it was divided into Upper and Lower Galilee, and was a fertile region with many towns and villages, thickly inhabited by Syrians, Phœnicians, Arabs, Greeks and Jews. The Jewish inhabitants, on account of their ignorance, simplicity of manners and less rigid sentiments in regard to religion, were held in contempt by other Jews; but after the destruction of Jerusalem despised Galilee became the refuge of the doctors of Jewish law, and the city of Tiberias the seat of Rabbinical learning. As the cradle of Christianity and the scene at Nazareth, Cana, Capernaum, the Lake of Gennesaret, Mount Tabor and other localities, of a great deal of Christ's ministry on earth, Galilee has world-wide interest. Consult Merrill, 'Galilee in the Time of Christ' (New York 1885); id., 'East of the Jordan' (ib. 1881); Smith, George Adam, 'Historical Geography of the Holy Land' (London 1894); Masterman, 'Studies in Galilee' (Chicago 1909).

GALILEE, Sea of, in biblical history also called the SEA OF CHINNERETH or CINNEROTH, LAKE OF GENNESARET and SEA OF TIBERIAS, is a large pear-shaped lake in the north of ancient Galilee (q.v.), Palestine. It lies 682.5 feet below sea-level; is 13 miles long by 8 broad and 150 feet deep. It occupies the bottom of a great basin, and is of volcanic origin. The Jordan flows into it red and turbid from the north, and it is fed also by many warm and brackish springs, but its waters are cool, clear and sweet. Its shores on the east and north sides are bare and rocky; on the west gradually sloping. For half the year the hillsides are bare, but in spring a subtropical vegetation abounds. Fish are plentiful and are caught with nets by a guild of fishermen. Sudden changes in temperature often cause violent storms. Near the shores of the lake are numerous ruins and sites of ancient settlements; the most notable of these are Talhoum (Capernaum), Kerazeh, the ancient Chorazin, Tubariya, the ancient Tiberias or Rakkath and Mejdel, supposedly the ancient Magdala. Kerak, at the southern end of the lake, has been identified by some as the city of Tarichea. The identification of the ruins and sites on the east shore is less satisfactory. In modern Arabic the lake is called *Bahr Tubariya,* often translated "Lake of Tiberias."

GALILEI, Galileo, gä-lē-lā'ō gä-lē-lā'ē, Italian physicist and astronomer: b. Pisa, 14 Feb. 1564; d. Arcetri, 8 Jan. 1642. His father, Vincenzo Galilei, an impoverished nobleman of Florence, caused him to be instructed in Latin and Greek, drawing and music, and he very early showed a strong inclination to mechanical labors. In 1581 Galileo entered the University of Pisa, to attend lectures on medicine and the Aristotelian philosophy. Here he became conspicuous in refusing to accept without question the dogmatic statements of his teachers. That spirit of observation for which he was distinguished was early developed. When he was only 19 the swinging of a lamp suspended from the ceiling of the cathedral in Pisa led him to discover the isochronism of the pendulum, which he was the first to apply as a measure of time. He studied mathematics under Ostilio Ricci, soon exhausted Euclid and Archimedes, and was led, by the works of the latter, in 1586, to the invention of the hydrostatic balance, by which the specific gravity of solids might be ascertained with much accuracy.

He now devoted his attention exclusively to mathematics and natural science, and in 1589 was made professor of mathematics in the University of Pisa. In the presence of numerous spectators he went through with his experiments, which he performed on the leaning tower of Pisa, to show that weight has no influence on the velocity of falling bodies. By this means he excited the opposition of the adherents of Aristotle to such a degree, that after two years he was forced to resign his professorship. Through the influence of the Marchese Guidobaldo, the Senate of Venice, in 1592, appointed him professor of mathematics in Padua. Here he remained till 1610.

He lectured with unparalleled success. Scholars from the most distant regions of Europe crowded about him. In 1597 he invented the sector.

One of the most important mathematical discoveries which he made at a period subsequent to this is that the spaces through which a body falls, in equal times, increase as the numbers 1, 3, 5, 7; that is, if a body falls 16 feet in the first second, it will fall 48 in the next second, 80 in the third, and so on. Whether the thermometer was his invention it is difficult to determine; perhaps he only improved it. By means of a telescope, constructed by himself, he made a series of the most important discoveries. He found that the moon, like the earth, has an uneven surface; and he taught his scholars to measure the height of its mountains by their shadow. A particular nebula he resolved into individual stars, and even conjectured that the whole Milky Way, with good instruments, might be resolved in the same manner. His most remarkable discovery was that of Jupiter's satellites, 7 Jan. 1610. He likewise observed Saturn's ring, though he had not a just idea with regard to it. He saw the sun's spots somewhat later, and inferred, from their regular advance from east to west, the rotation of the sun, and the inclination of its axis to the plane of the ecliptic.

Galileo's name, meantime, had grown so celebrated that Cosmo II, grand duke of Tuscany, appointed him grand-ducal mathematician and philosopher, and invited him to become first instructor in mathematics at Pisa. Here he gained a decisive victory for the Copernican system by the discovery of the varying phases of Mercury, Venus and Mars; as the motion of these planets about the sun, and their dependence on it for light, were thus established beyond the possibility of doubt. He wrote a work afterward on the floating and sinking of solid bodies in water, and in this, as well as in all his other writings, scattered the seeds of many new doctrines.

While thus employed in enlarging the field of natural philosophy, a tremendous storm was gathering about his own head. He had declared himself in favor of the Copernican system, in his work on the sun's spots, and was therefore denounced as a heretic by his enemies. In 1611 he visited Rome for the first time, where he was honorably received, and where a favorable report was made on his writings by the mathematicians of the Collegio Romano at the instance of Cardinal Bellarmin. On his return to Florence, however, he became more and more involved in controversy, which gradually took a theological turn, and in the course of which he declared the literal understanding of the utterances of Scripture with regard to physical phenomena to lead to absurdities. From Rome he received, in the name of the Cardinal Barberini (afterward Pope Urban VIII), the warning not to overstep the limits of mathematics and physics, but he paid no heed to the well-meant advice. The monks preached against him, and in 1616 he found himself again obliged to proceed to Rome, where he is said to have pledged himself to abstain for the future from promulgating his system either orally or otherwise. The genuineness of the document on the basis of which this is asserted, has, however, been questioned in modern times, and the controversy regarding this matter is not yet finally settled.

In 1618 the appearance of three comets gave him an opportunity to communicate to his friends some general observations, on these bodies. His scholar, Mario Guiducci, wrote a work immediately after, in which he severely condemned the Jesuit Grassi. Supposing Galileo to be the author, Grassi attacked him. Galileo replied in his 'Saggiatore,' a masterpiece of eloquence, pronounced by Algarotti to be the finest controversial work Italy has ever produced, and, notwithstanding the errors contained in it, a work always worthy to be read.

About this time he completed his famous work, in which, without giving his own opinion, he introduces three persons in a dialogue ('Dialogue on the Two Chief Systems of the World'), of whom the first defends the Copernican system, the second the Ptolemaic, while the third appears as a blind and unreasoning supporter of the views of Aristotle. With this work, in which the greatest elegance and accuracy of style is united with the clearest and most concise statements, Galileo went to Rome in 1630, and succeeded in obtaining the privilege to print it. Having obtained the same permission in Florence, he published it there in 1632—'Dialogo di Galileo Galilei, dove ne' Congressi di quattro Giornate si discorre de' due massimi Sistemi del Mondo, Tolemaico et Copernicano.' Scarcely had it appeared when it was attacked by the disciples of Aristotle, and most violently of all by Scipione Chiaramonti, teacher of philosophy at Pisa. A congregation of cardinals, monks and mathematicians examined his work, condemned it as highly dangerous, and summoned him before the tribunal of the Inquisition. The veteran philosopher was compelled to go to Rome, and in June 1633 was condemned to renounce, in presence of a great assembly, kneeling before them, with his hand upon the gospel, the great truths he had maintained. «Corde sincero et fide non ficta, abjuro maledico et detestor supradictos errores et hereses,» was the formula which he was compelled to pronounce. His famous whisper, «But nevertheless it [the earth] does move,» is a fiction. He was sentenced to the dungeons of the Inquisition for an indefinite time, and every week, for three years, was to repeat the seven penitential psalms of David. His 'Dialogo' was prohibited and his system condemned as contrary to the Bible. His judges were merciful enough to commute his sentence of imprisonment to banishment to the villa of the grand duke of Tuscany at Rome, then to the archiepiscopal palace at Sienna, and soon after he was allowed to return to Arcetri, not far from Florence.

He employed his last years here principally in the study of mechanics and projectiles. The results are found in two important works on the laws of motion, the foundation of the present system of physics and astronomy. At the same time he tried to make use of Jupiter's satellites for the calculation of longitudes; and though he brought nothing to perfection in this branch, he was the first who reflected systematically on such a method of fixing geographical longitude. He was at this time afflicted with a disease in his eyes, one of which was wholly blind, and the other almost useless, when, in

1637, he discovered the libration of the moon. Blindness, deafness, want of sleep and pain in his limbs united to embitter the last years of Galileo's life. He died in the year Newton was born, and his relics were ultimately deposited in the church of Santa Croce, at Florence, where a splendid monument was erected to him near that of Michelangelo.

Galileo was of diminutive size, but strong and healthy. His countenance was agreeable; his conversation lively. He loved music, drawing and poetry. He knew Ariosto by heart; and in one of his works, first printed in 1793, 'Considerazioni al Tasso,' the product of his leisure hours, he points out the superiority of Ariosto to Tasso, whom he criticizes very severely. His style is lively, natural and fluent. His collected works have been edited by Alberi (16 vols., Florence 1842–56). Consult Brewster, 'Martyrs of Science' (London 1841); Chasles, 'Galileo Galilei' (Paris 1862); Epinois, H. de l', 'Les Pièces due procès de Galilée' (1877), and 'La question de Galilée' (1878); Fahie, J. J., 'Galileo: his Life and Work' (London 1903); Favaro, A., 'Galileo Galilei' (Florence 1882); Gebler, K. von, 'Galileo Galilei und die Römische Kurie' (1876); Wegg-Prosser, F. R., 'Galileo and his Judges' (Eng. trans., London 1889).

GALIMBERTI, gä-lēm-bār'tē, **Luigi,** Italian cardinal and diplomat: b. Rome 1838; d. 1896. He became professor of church history in the College of the Propaganda and of theology in the University of Rome, and was appointed by Pius IX canon of the Lateran in 1868. From Leo XIII he received appointment as canon of Saint Peter's, archbishop of Nicæa, and secretary to the Congregation of Extraordinary Ecclesiastical Affairs. He was papal arbiter in the award to Spain, as against Germany, of the Carolines, and in 1880 was sent as ambassador to Germany, where he was successful in adjusting the difficulties of the «Kulturkampf» through the abrogation by the Crown of the so-called «May Laws.» In 1893 he was made a cardinal and prefect of the papal archives.

GALINÉE, gäl-ē-nā, **René de Brehant de,** Sulpician missionary: b. Brittany; d. 1678. He came to Canada in 1668, and in 1669–70, in company with Dollier de Casson (q.v.), made a notable journey, in the course of which they explored Niagara, the north shore of Lake Erie and the east and north shores of Lake Huron, and took formal possession of the country in name of Louis XIV. On their return to Montreal Galinée made a map of their explorations — the first map of the upper lakes made at first hand, and one which marked a notable advance in cartographical knowledge.

GALION, Ohio, a city in Crawford County, on the Erie and the Cleveland, Cincinnati, Chicago and Saint Louis railroads, 80 miles southwest of Cleveland. Galion is an important railroad town, being a connecting point and division terminal. There are railroad shops and round-houses here, brick and tile works, carriage and wagon factories, wheel and gear works, iron foundries and lumber mills. The town was originally laid out in 1831, by settlers from western Pennsylvania, and was chartered as a city in 1878. The city owns and operates its electric light and water plants. The government is composed of a mayor, who holds office for two years, and a common council, elected by popular vote. Pop. 7,214.

GALITZIN, gäl-ĕt'sĕn, or **GOLITZIN,** the name of a noble Russian family, whose members have been equally prominent in war and diplomacy from the 16th century downward. VASILI, surnamed the Great (b. 1643; d. 1714); was the councilor and favorite of Sophia, the sister of Peter the Great, and regent during his minority. His great aim was to bring Russia into contact with the west of Europe, and to encourage the arts and sciences in Russia. His design to marry Sophia and plant himself on the Russian throne miscarried. Sophia was placed by her brother in a convent and Vasili banished (1689) to Siberia and later to Archangel. ADELHEIDEN AMALIE, PRINCESS GALITZIN (1748–1806), daughter of the Prussian general, Count von Schmettau. She was noted for her literary culture, her sympathetic relations with scholars and poets, but, above all, for her ardent piety, which found in Catholicism its most congenial sphere. Having separated from her husband, Prince Dimitri Alexievitch, she took up her residence in Münster, where she gathered round her a circle of learned companions. PRINCE DYMITRI ALEXIEVITCH, diplomat (b. 1735; d. 1803). He was ambassador to the court of France in 1763, and to The Hague in 1773, and was the author of several works relating to geology.

GALL, Saint, Irish monk: b. Ireland about 550; d. Saint Gall, Switzerland, about 645. He accompanied Saint Columba to France about 585 and took part with him in all his missionary labors. Banished from France, they went together into the wilder regions of Switzerland, and near the Lake of Constance they founded the monastery which bore the name Saint Gall and gave name to the town and canton of Saint Gall. After a few years Columba retired to Italy, leaving his companion abbot of the new house. The monastery was burnt by Hungarians in the 10th century.

GALL, gäl, **Franz Joseph,** German phrenologist: b. Tiefenbronn, Baden, Germany, 9 March 1758; d. Montrouge, near Paris, 22 Aug. 1828. He studied medicine at Strassburg and Vienna, and settled in the latter city in 1785 as a physician. In 1796 he began to give courses of lectures on phrenology (q.v.) in Vienna; but these lectures were prohibited in 1802 by the Austrian government as being subversive of the accepted religion. With Spurzheim, who became his associate in 1804, he quitted Vienna in 1805, and began a lecturing tour through Germany, Holland, Sweden and Switzerland. He reached the height of his fame when in 1807 he settled as a physician in Paris. On 14 March 1808 he and Spurzheim presented to the Institute of France a memoir of their discoveries, on which a committee of the members of that body (including Pinel, Portal and Cuvier) drew up an unfavorable report. Thereupon Gall and Spurzheim published their memoir, 'Introduction to Physiology of the Brain'; this was followed by 'Researches on the Nervous System' (1809), and by 'Anatomy and Physiology of the Nervous System' (1810–19) with an atlas of 100 plates. In 1811, in answer to accusations of materialism and fatalism brought against his system, Gall published 'Of the Innate Inclinations of the Soul and

Spirit.' He continued to practise medicine and pursue his researches at Montrouge, near Paris, till his death. See SPURZHEIM, KASPAR.

GALL. See BILE.

GALL, Abbey of Saint. A Benedictine abbey in the canton Saint Gall, Switzerland. It was founded in the 7th century and placed under the patronage of Saint Gall, or Gallus, an Irish missionary and a disciple of Saint Columbanus. Saint Gall died in 646 and a chapel was erected on the site of his cell by Charles Martel. Under his patronage and that of his son, Pepin, a community of monks grew up there and the monastery was dedicated to Saint Gall. Under Othmar, the first abbot, a school was founded which soon acquired a great influence. The early years of the abbey were marked by frequent conflicts with the bishops of Constance, who refused to recognize the exemptions and other privileges of the community, but in the time of Louis the Pious its rights were confirmed and its independence secured. In the 9th century the library was considerably enlarged and a catalogue, prepared at that time and still in existence, shows the possession of manuscripts on a wide range of subjects. In the 13th century the importance of the abbey as a centre of religion and learning waned. This may have been due in part to the fact that at this time the town became an independent principality over which the abbots ruled as territorial sovereigns. After the Reformation the town threw off the rule of the abbots. At this time many of the most valuable books and manuscripts were carried away. In 1530, under Abbot Diethelm, the library and schools were restored and later in the century a printing press was established there which eventually became one of the most important in Switzerland. In 1712 the abbey was raided by the Swiss who carried away many books and manuscripts to Zürich, Berne and other cities. By a curious irony of fortune the abbot was obliged at this time to place the abbey under the protection of the townspeople, who had once been the subjects of his predecessors. After this trouble a final attempt was made to restore the library and schools, but in 1798 the Swiss Directory suppressed the ecclesiastical principality and secularized the abbey. In 1846 Saint Gall was erected into a separate bishopric, with the abbey church as its cathedral. A portion of the monastery was assigned as the bishop's residence and the rest used for the offices of the civil government and the remains of the library.

THOMAS GAFFNEY TAAFFE.

GALL-BLADDER, the reservoir for the bile, a pear-shaped membranous sac, about four inches long, one inch in breadth at its widest part and holds from an ounce to an ounce and a half, is lodged in a depression on the under surface of the right lobe of the liver. Its fundus or broad extremity is directed downward and forward and occasionally projects a little beyond the edge of the liver, almost touching the abdominal wall about three inches from the middle line of the body, its body and neck extend upward and backward. The bile is conveyed to the small intestine by biliary ducts or canals about the size of a quill except when distended. The cystic duct, the smallest, and about an inch in length joins the neck of the gall bladder with the hepatic duct, about one inch and a half long, which issues from the liver and so is formed the common excretory duct of the liver and gall bladder, the largest of the biliary ducts and about three inches in length, which empties into the duodenum. Bile is not conveyed into the intestine until it is needed in the process of digestion, but as secreted in the liver passes into the gall-bladder through the hepatic and cystic ducts to be stored until needed.

Catarrhal cholangitis, acute or chronic, is an inflammation of the lining membrane of the ducts, causing swelling of them and obstruction to the flow of bile. Usually it is an extension of a gastritis or duodenitis, or may be due to the presence of gall stones, to stricture, to cancerous disease or pressure from enlarged or contracted liver, etc. Whenever there is an interference with the flow of bile from the liver there is usually jaundice more or less pronounced. Catarrhal jaundice is attended by few symptoms, no emaciation, some discoloration of skin, liver little larger than usual and tender to pressure — usually runs a course of about six weeks. Marked jaundice coming on gradually and attended by severe pain-points to gall stones or something worse. Biliousness, sallow complexion, depression of spirits, digestive disturbance is probably more often due largely to a deficient flow of bile rather than to an excessive amount, and may end in gall stones.

Cholecystitis, inflammation of the gall-bladder due to infection by microbes from the intestines may be a mild catarrh, or suppuration may occur leading to perforation and peritonitis. If a severe attack there is violent pain, great tenderness and a high temperature. If persistent, and especially if stones are believed to be present, an operation is necessary. Cholelithiasis, the tendency to the formation of gall stones, occurs mostly among persons engaged in sedentary occupations who take but little if any exercise in the open air and who eat too much nitrogenous and fatty food. The bile becomes too thick and is retained, and stagnant, infection occurs and gall-stones form chiefly from cholesterine, a normal constituent of the bile. The congestion of the biliary tracts may result from poisons taken into the body or manufactured within the body, from interference with the circulation of the liver, and from displacements of the liver.

Gall-stones, even in large numbers (100 or more) may be formed and held in the gall-bladder for years without causing discomfort, but there is always the tendency to local inflammation of the gall-bladder or of one or more stones being forced into the cystic or common duct, damming back the bile, causing adhesions and intense pain. Getting rid of gall-stones by medicines is unsatisfactory. There is no known solvent. Operation for their removal in obstinate cases is necessary. Statistics show that only 1.4 per cent of operated cases die, under the care of experienced surgeons. The operation is not so much in reality to get rid of the stones as to get rid of the bacteria causing infection, and of inflammation, irritating fluids, etc.

Hepatic or gall-stone, colic, is the name given to the intense cramp that accompanies the passage of a gall-stone through the bile-ducts or an attempt at such a passage. There is a sudden excruciating pain in the right side at the free border of ribs or even over the whole abdomen; frequently the pain may shoot up to the right shoulder blade and arm. The patient rolls and tosses in agony with his face suffused with cold perspiration. Sometimes there is a chill followed by fever. The duration depends on the course of the stone; frequently relief is had in a few hours, only soreness remaining.

Cholecystectomy — surgical removal of the gall-bladder, now-a-days quite frequently resorted to.

Cholecystotomy — surgical incision of the gall-bladder.

Cholecystastomy — surgical creation of permanent opening into gall-bladder through the abdominal wall.

GALL-FLY, one of the several minute gall-making insects, as the British ash-fly. See GALLS AND GALL-MAKERS.

GALL-GNATS, a gall-making gnat of the genus *Cecidomyia.* See GALLS AND GALL-MAKERS.

GALL-STONE. See CALCULUS.

GALLA. See NUT-GALLS.

GALLAIT, gä-lā, **Louis,** Belgian historical painter: b. Tournai, Belgium, 10 May 1810; d. Brussels, 20 Nov. 1887. He studied in Tournai, Antwerp and Paris, where he acquired a name by his portraits as well as his genre and historical paintings. Among his earlier pictures of note were 'Christ Restoring Sight to a Blind Man' purchased by subscription and presented to Tournai Cathedral; 'The Strolling Musicians'; 'The Beggars'; 'Montaigne Visiting Tasso in Prison'; 'Abdication of Charles V.' Among his subsequent pictures are 'Temptation of St. Anthony'; 'The Dead Bodies of Counts Egmont and Hoorn'; 'The Prisoner's Family'; 'The Last Moments of Count Egmont'; 'Alva Signing Death Warrants'; and lastly (1882), 'The Plague at Tournai,' purchased for Brussels Museum at the price of $24,000. He painted several of his best historical works for the French government. He had a powerful influence on modern art not only in his native country but throughout Europe; it was especially felt in Germany. Consult Dujardin, 'L'Art flamand' (Brussels 1899); Henne, 'Louis Gallait' (in *Annales de l'academic Belgique,* Brussels 1890); Muther, 'Die belgische Malerei im 19ten Jahrhundert' (Berlin 1904); Teichlin, 'Gallait und die Malerei in Deutschland' (Berlin 1853).

GALLAND, gä-lŏṅ, **Antoine,** French Orientalist and archæologist: b. Rollot, France, 4 April 1646; d. Paris, 17 Feb. 1715. Attached in 1670 to the French embassy at Constantinople, he three years later accompanied the ambassador to Syria and the Levant. In 1676, and again in 1679, he made other visits to the East. In 1701 he was made a member of the Académie des Inscriptions, and in 1709 professor of Arabic in the College de France. The greatest part of his writings relate to archæological subjects, especially to the numismatics of the East; but the work which has secured him the greatest reputation is his translation of the 'Arabian Nights Entertainments' (1704–17), the first translation of these stories made into any language of Christendom. Among his other writings are 'Remarkable Sayings, Witticisms and Maxims of the Orientals' (1694), and 'The Indian Tales and Fables of Pilpay and Lokman' (1724). See ARABIAN NIGHTS, THE.

GALLARDO, gäl-lär'dō, **Aurelio Luis,** Mexican poet: b. León, Guanajuato, Mexico, 3 Nov. 1831; d. Napa, Cal., 27 Nov. 1869. He published three volumes of poems: 'Dreams and Visions' (Mexico 1856); 'Clouds and Stars' (Guadalajara 1865); and 'Legends and Romances' (1868); also a collection of poems, 'Home Stories.' He wrote many comedies. The drama, 'Maria Antonieta of Lorena' is regarded as his best work.

GALLAS, gäl'läz, a Hamitic people inhabiting Africa approximately between lat. 9° N. and 3° S. and long. 34° and 44° E. Their language is a descendant of the ancient Geez of Abyssinia. Though they bear a perceptible strain of Negro blood, they are the purest type of the Ethiopian branch of the Hamitic race. They are tall, with good, often European, features, strong, well-made limbs, skin of a light chocolate brown, hair frizzled but not woolly. Though cruel in war they are frank and faithful to promises and obligations. They are distinguished for their energy, both physical and mental especially the southern tribes, which pursue pastoral vocations, notably the breeding of horses, asses, sheep, cattle and camels, and those which live by hunting, especially the elephant. These same tribes are mostly still heathens, though Mohammedanism is rapidly making way among them. The more northerly tribes who dwell about Harar profess a crass form of Christianity, derived from Abysinnia, and for the most part raise cotton, durra, sugar and coffee. The total Galla population, who call themselves Ilm 'Orma (Sons of Men, or Sons of the Brave), is estimated at upward of 3,000,000. Politically they are divided into a great number of separate tribes, which are frequently at war with one another. But their inveterate foes are the Somali, who have gradually driven back the Galla from the shores of the Red Sea and the extremities of the Somali peninsula regions which were occupied by them in the 16th century, just as on the other side the Abyssinians and Shoans have beaten them back. The country they now inhabit is a plateau northwest of the Indian Ocean, with a hilly, well-timbered surface. Consult Keane, A. H., in Stanford's 'Africa' (Vol. I, London 1907); Salivac, P. M. de, 'Les Galla' (Paris 1901); Smith, A. Donaldson, 'Through Unknown African Countries: First Expedition from Somaliland to Lake Lamu' (London 1897).

GALLATIN, Abraham Alfonse Albert, generally known as ALBERT GALLATIN, American statesman and diplomat, and one of the foremost public financiers of the United States: b. Geneva, Switzerland, 29 Jan. 1761; d. Astoria, N. Y., 12 Aug. 1849. In 1773, both his parents having died a few years previously, the boy was sent to a boarding-school and in August 1775 to the Academy of Geneva, from which he graduated in May 1779, the first in his class in mathematics, natural philosophy and Latin translation. In 1780, after refusing a commission as lieutenant-colonel of a regiment of mercenaries under the Landgrave of Hesse, he and a friend, Henri

Serre, secretly left Geneva for the United States and established themselves in business at Machias, Me., but in 1781 abandoned this unsuccessful enterprise, Gallatin going to Boston where he supported himself by teaching French. In July 1782 he received permission to teach French in Harvard College, in which occupation he remained for about a year. In July 1783 he left Boston and purchased several thousand acres of land on the south side of the Ohio between the Monongahela and Kanawha rivers, in March 1784 establishing himself in a country store in Fayette County, Pa. In May 1789, against the wish of her mother, he married Sophie Allègre, but in the following October she died.

Gallatin had early evinced an intense interest in the political affairs of his adopted country and, after the adoption of the Constitution by the Federal Convention, joined the Anti-Federalists (q.v.). In September 1788, after Pennsylvania had ratified the Constitution, Gallatin represented Fayette County at a conference at Harrisburg for the purpose of suggesting amendments. In 1789–90 he was a delegate to a convention called to revise the constitution of Pennsylvania, and in October 1790, as also in the two following years, was elected to represent Fayette County in the State legislature. In this body he was conspicuously active, being a member of 35 committees, preparing all their reports and drawing all their bills, his report prepared for the committee of ways and means of the session of 1790–91, laying the foundation of his reputation. He bitterly opposed the excise laws, acting as secretary of meetings and drafting resolutions which, if not criminal, at least reached the utmost limit of indiscretion and expressed sentiments which he himself later acknowledged to be «violent, intemperate, and reprehensible.» On 28 Feb. 1793 the Pennsylvania legislature elected Gallatin a United States Senator and on 2 December he took his seat, but on 28 Feb. 1794 the Senate refused his admission to that body because he had not actually been a citizen for nine years as prescribed in the Constitution. On 11 Nov. 1793, prior to taking his seat in the Senate, he had married Hannah Nicholson, daughter of Commodore James Nicholson, and for a few months was engaged in cultivating his lands, but in 1794 again plunged into the vortex of public life in connection with the Whisky Insurrection (q.v.). In October 1794 he was elected both to the State legislature and to Congress; his election to the legislature was declared void on 9 Jan. 1795, but he was immediately re-elected and sat from 14 February to 12 March, when he was granted leave of absence. In December 1795 he took his seat in the House of Representatives, joining the Republican party, became a member of the finance committee, and immediately exhibited his grasp of national affairs and his unique financial talents. He steadfastly opposed the Jay treaty (q.v.) and the increase of the army and navy, earnestly advocated the protection of the frontier, favored direct taxes, criticized the operations of the Treasury Department, objected to the manner of handling relations with France, fought the passage of the Alien and Sedition laws (q.v.) and by 1801 had become a powerful influence in the councils of his party.

Gallatin's 'Sketch of the Finances of the United States' (1796) and his 'Views of the Public Debt, Receipts and Expenditures of the United States' (1800) gained for him great renown as an economist and statistician, and together with his known abilities as an administrator of public finances brought him in 1801 the appointment as Secretary of the Treasury, which office he held continuously until 1813. He persistently urged and to a considerable degree effected a rigid economy in governmental financial operations, improved the internal revenue and sinking fund systems, reduced the public debt, provided funds to carry on the war without disturbing the financial system of the country, and devised a comprehensive plan for internal improvements. (See UNITED STATES — FINANCES OF THE, 1789–1816). He also ably but unsuccessfully urged the renewal of the charter of the Bank of the United States. Always a free-trade advocate, in 1831 he was the leading spirit in a free-trade convention at Philadelphia, drafting a memorial on that subject for presentation to Congress. His views on finance and banking were eagerly sought, among his notable essays on these subjects being 'Considerations on the Currency and Banking System of the United States' (1830) and 'Suggestions on the Banks and Currency of the United States' (1841).

In 1813 Gallatin was sent to Saint Petersburg as one of the commissioners to urge Russian mediation between Great Britain and the United States, but as he had not resigned from the Treasury, the Senate in July 1813 withheld confirmation and in January 1814 he left Saint Petersburg. A few weeks later, however, he received a regular appointment as one of the peace commissioners to settle the War of 1812 and materially influenced the shaping of the Treaty of Ghent (q.v.). In 1815, with Adams and Clay, he also negotiated a commercial convention with Great Britain. On his return home he declined a nomination to Congress and a second appointment to the Treasury portfolio, preferring diplomatic life instead, and from 1816 to 1823 rendered inestimable service as Minister to France. He aided Richard Rush at London in negotiating a new commercial convention with Great Britain and signed the compromise convention of 20 Oct. 1818. In 1824, after his return to New York, the Crawford Republicans nominated him for Vice-President but in October he withdrew in favor of Clay. A year later he declined to represent the United States at the proposed Congress of American republics at Panama, but in the spring of 1826 accepted an appointment as Minister to Great Britain, prior to his return in 1827 negotiating several important conventions. With his return to New York Gallatin's diplomatic career terminated, but during the next two years he prepared a statement of facts regarding the northeastern boundary to be laid before the King of the Netherlands. In 1846 he rendered his last diplomatic service when he published a pamphlet entitled 'The Oregon Question.' He protested against the annexation of Texas and in 1847 published a pamphlet entitled 'Peace with Mexico.'

The last years of Gallatin's life were in a large measure devoted to scientific researches, since his position as president of the National Bank of New York, which he occupied for several years, allowed him ample time for study;

he declined to re-enter public life, in 1843 refusing President Tyler's offer of the Treasury portfolio. He ardently supported all educational movements and actively assisted in founding New York University; but his chief interest was research in the field of American ethnology. He had previously made an extensive study of the Indians and their languages, publishing several essays on the subject, but after his permanent settlement at New York he made a deeper and more scientific investigation, in 1836 publishing 'A Synopsis of the Indian Tribes within the United States, East of the Rocky Mountains, and in the British and Russian Possessions of North America.' In 1842 he founded in New York the American Ethnological Society and three years later in the first volumes of its 'Transactions' published an 'Essay on the Semi-Civilized Nations of Mexico and Central America, Embracing Elaborate Notes on their Languages, Numeration, Calendars, History and Chronology, and an Inquiry into the Probable Origin of their Semi-Civilization.' From 1843 until his death in 1849 Gallatin was president of the New York Historical Society and despite his age never lost interest in his historical, economic and scientific pursuits. Consult Adams, Henry, 'Life of Albert Gallatin' (Philadelphia 1879), and 'The Writings of Albert Gallatin' (3 vols., Philadelphia 1879); Bartlett, J. R., 'Reminiscences of Albert Gallatin' (in 'New York Historical Society Proceedings' for 1849, pp. 281–98); Gallatin, Albert, 'Autobiography' (in 'Maine Historical Society Collections,' Vol. VI, pp. 93–103, 1859); Gallatin, James, 'A Great Peace Maker: the Diary of James Gallatin, Secretary of Albert Gallatin, U. S. Envoy to France and England 1813–27 and Negotiator of the Treaty of Ghent,' edited by Count Gallatin (London 1914); Hale, E. E., 'Memoir of Albert Gallatin' (in 'American Antiquarian Society Proceedings,' 23 Oct. 1849); Meany, Edward S., 'Three Diplomats Prominent in the Oregon Question' (in *Washington Historical Society Quarterly*, Vol. V, pp. 207–14, Seattle, Wash., 1914); Stevens, John A., 'Albert Gallatin' (Boston 1890).

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GALLATIN, Mo., city and county-seat of Daviess County, on the Wabash and the Chicago, Rock Island and Pacific railroads, and on the Grand River, 55 miles northeast of Saint Joseph. It is in a farming region, has lumber industries, municipal waterworks and an electric-light plant, and an academy. Pop. 1,825.

GALLATIN, Tenn., town and county-seat of Sumner County, on the Louisville and Nashville Railroad, 27 miles northeast of Nashville and three miles from the Cumberland River. Its industrial and commercial activities are connected with stock-raising, agricultural products, lumbering, cotton and woolen manufactures, flour milling and foundry and machine products. It contains a training school and the Howard Female College. Pop. 2,399.

GALLAUDET, găl-â-dĕt', **Edward Miner,** American educator: b. Hartford, Conn., 5 Feb. 1837; d. 26 Sept. 1917; son of Thomas H. Gallaudet (q.v.). He was graduated at Trinity College in 1856. He organized the Columbia Institute for the Deaf, Dumb and Blind in Washington, D. C., in 1857, and from it developed the Gallaudet College for the Deaf, of which, in 1864, he became president (May 1911 emeritus president). His publications include 'Manual of International Law' (1879), and 'Life of Thomas Hopkins Gallaudet' (1888).

GALLAUDET, Thomas, American Episcopal clergyman: b. Hartford, Conn., 3 June 1822; d. 27 Aug. 1902. He was a son of T. H. Gallaudet (q.v.); he was graduated at Trinity College in 1842; was teacher in the New York Institution for Deaf-Mutes 1843–58. He was ordained in 1851; founded and became rector of Saint Ann's Church, New York, for deaf-mutes, in 1852; was appointed general manager of the Protestant Episcopal Church Mission to Deaf-Mutes in 1872; and founded the Gallaudet Home for Deaf-Mutes, near Newburg, N. Y., in 1885.

GALLAUDET, Thomas Hopkins, American educator: b. Philadelphia, 10 Dec. 1787; d. Hartford, Conn., 9 Sept. 1851. In 1817 he founded at Hartford, Conn., the first deaf-mute institution in America and was president of the same till 1830. In 1838 he became chaplain of the Insane Asylum at Middletown, Conn., where he remained till his death. He was the author of 'Bible Stories for the Young' (1838), and 'The Child's Book of the Soul,' etc. Consult Lives by Humphrey (1858), and Gallaudet, E. M. (1888); Barnard, 'Tribute to Gallaudet.'

GALLAVRESI, gäl-lä-vrā-ze, **Giuseppe,** Italian paleographer: b. Milan, 26 June 1879. He was educated in private schools, the University of Genoa, and the Royal School of Paleography of Milan. Since 1905 he has been a trustee of the Museum at Castello Sforzesco, Milan, and since 1908 has been lecturer on modern history at the Royal Academy in the same city. He has been very active in Catholic social work, has served as general secretary of the Aid Society for Italian Workmen Abroad, is member of the Royal Historical Commission of Italy, the Society of Social Science. He is a knight of the Crown of Italy and honorary attaché of the Royal Italian Legation, Berne. He has written 'Nava Memoirs' (1902); 'Carteggio del Conte Federigo Confalonieri' (1910); 'Electoral Law of the Cisalpine Republic,' etc. He is a contributor to 'Nuova Antologia,' 'Rassegna Nazionale,' 'Archivio storico italiano'; 'Archivio storico lombardo'; 'Giornale storico della litteratura italiana'; 'Il libro e la stampa'; *Correspondant*, *Revue des questions historiques*, *Revue d'histoire diplomatique*. Since 1910 he has been editor of *Rassegna storica del Risorgimento Italiana*.

GALLE, gäl'le, **Johann Gottfried,** German astronomer: b. in Pabsthaus, Prussia, 9 June 1812; d. Potsdam, 11 July 1910. He studied natural sciences and mathematics in Berlin 1830–33; discovered three comets in 1839–40; was the first to observe the planet Neptune (23 Sept. 1846); and in 1851 became director of the observatory in Breslau and professor of astronomy in Breslau University. In 1875 he advocated planetoid observations to determine the solar parallax. Among his published works are 'Grundzüge der schlesischen Klimatologie' (Breslau 1857); 'Ueber eine Verbesserung der Planetenelemente' (Breslau 1858); 'Neber eine Bestimmung der Sonnenparallaxe aus Korrospondierenden Beobachtungen der Flora im Oktober und November 1873' (Breslau 1875); 'Mitteilungen der Breslauer Sternwarte' (Breslau 1879); 'Verzeichnis der Elemente der bisher berechneten Kometenbahnen' (Leipzig 1894).

GALLEGO, gä-yä'gō, **Juan Nicasio**, Spanish poet: b. Zamora, 14 Dec. 1777; d. Madrid, 9 Jan. 1853. He was possessed of great natural poetical talent; but he was careless and, in a sense, indolent so that his life's work does not correspond to his talents. Graduated from the University of Salamanca, he entered the Church and became Court chaplain in 1805. It was in Madrid that he became acquainted with Quintana and Cienfuegos and other men of literary and other note. This friendship encouraged him to literary exertions, which were broken by the entrance of the French into Madrid in 1808. On this occasion Gallego wrote 'El dos de mayo,' one of his best known poems. Losing his position on account of the political changes at this time, he soon became noted as one of the best poets of Spain. His burning patriotism and love of independence coupled with his fight for the freedom of Spain appealed to the nation; and his compositions were passed from hand to hand throughout the land and read in every household. On the return of the French to Madrid, Gallego went to Seville and from there finally to Cadiz; where he seems to have led a rather active existence until the return to power of the Spanish government in 1814. In 1810 he was elected deputy from the Isle of León to the Cortes and he gave so much attention to his political duties that he had apparently little time left for literary work. On account of this political activity, he was imprisoned for 18 months on the return to the throne of Fernando VII, in a public prison, after which he was sent to Cartuja de Jerez, where he was held until 1816, when, owing to his ill health, he was taken to La Luz Monastery at Moguer, and later to Loreto Convent in Seville, where he remained until he was freed by the revolution in 1820. Shortly afterward he was appointed Archdeacon of Valencia, a position he held until he was deposed by royal order, in opposition to the laws of the Church, and on account of his former political activities, and he was compelled to go to Barcelona, then held by the French; and from there he went to France on the retirement of the French. Later on he returned to Spain and was appointed Canon of Seville.

GALLEGOS, gäl-yä'gōs, Argentina, a river and city in the extreme southern part. The river rises in the Latorre Mountains and empties into the Atlantic Ocean; length 160 miles. The city is near the mouth of the river in Santa Cruz Territory and has a population of about 5,000.

GALLEIN, găl'ẹ-ĭn (*Pyrogallolphthalein*), a coal-tar color used in dyeing. Formula, $C_{20}H_{10}O_7$. Obtained by heating for some hours one part of phthalic anhydride with two parts of pyrogallol from 190° to 200°, then dissolving the fused mass in alcohol, precipitating with water, and recrystallizing from dilute hot alcohol.

GALLENGA, găl-lĕn'gä, **Antonio Carlo Napoleon**, Italian publicist and historian: b. Parma, Italy, 4 Nov. 1810; d. Llandogo, Wales, 17 Dec. 1895. He left Italy in 1831 by reason of political disturbances in which he took a part. He visited the United States and France. Returning to Italy he became more deeply involved in political intrigue. Finally he again became exiled because he could not agree with the policy of assassination held to by his party by which he had been selected to murder Charles Albert, king of Sardinia. Going to London (1843) he was elected to the chair of Italian literature in University College. He took part in the insurrection in Italy in 1848; and he returned in 1854; and was a member of the Italian Parliament 1858–64. He was long the London *Times'* special correspondent in Italy. His works, many of them issued under the name of "L. Mariotti," include 'Italy, Past and Present' (1841–49); 'Castellamonte, an Autobiography' (1854); 'Mariotti's Italian Grammar,' which went through 12 editions; 'History of Piedmont' (1855–56); 'The Pearl of the Antilles' (1873); and several books of travel.

GALLEON, a name formerly given to a very large kind of a vessel, with three masts and three or four decks, such as those used by the Spaniards in their commerce with South America, to transport the precious metals. They were large, clumsy, square-sterned vessels, having bulwarks three or four feet thick, all of which were so encumbered with tophamper and so overweighted in proportion to their draft of water, that they could bear very little canvas, even with smooth seas and light wind.

GALLERY, *in architecture*, any of various rooms, corridors, platforms, etc.: (1) A corridor or long, narrow room, sometimes serving as a means of access to other parts of a house; especially, a covered space for walking, partly open at the side; in English country houses, a main corridor having a continuous row of windows on one side. Galleries of this class include the low, paneled halls of the old châteaux and manor houses, particularly English houses of the 16th and 17th centuries; here were kept family portraits, arms and armor, trophies of the chase, banners, fine furniture, bric-a-brac, etc. (Compare (4) below). Belonging to this class also are such galleries as the one connecting the Sainte Chapelle with the Palais de Justice at Paris and the one connecting the Palazzo Pitti with the Palazzo Vecchio at Florence. (2) A long, narrow platform, balcony or passage projecting from a wall and open at the outer side except as having a balustrade or railing; especially, a passage either within the thickness of a wall, or supported on corbels, having its open side toward the interior of a building and serving both for ornament and as a means of communication. It is connected in some intimate way with the architectural design of the building. To this class belong the triforium and external galleries of many Gothic churches. These galleries are often filled with statuary, as the *galerie des rois* at the cathedrals of Paris and Amiens and at the ruined cathedral of Rheims. (3) A platform, supported by columns, brackets, or the like and projecting from the interior wall of a building, as a church or theatre, usually to provide additional room for an audience; specifically in a theatre, the highest of such platforms, containing the cheapest seats. (4) A room, typically long and narrow, or a building, for the exhibition of works of art. Famous galleries are the Louvre at Paris, the Uffizi and Pitti at Florence, the Vatican and Borghese at Rome, and the National at London. Other galleries containing renowned paintings or sculptures are at Versailles, Venice, Milan, Petrograd, Madrid, Dresden, Vienna, New York, etc. (5) A place of business or pleasure shaped like a gallery or in some way analogous to it; as a photograph gallery, a shooting gallery.

As a nautical term, gallery means a platform outside the body of the ship, at the stern or at the quarters. It was formerly common. *In mining,* a working drift or level. *In fortification,* any sunk or cut passageway that is covered both overhead and at the sides.

GALLEY, the ancient and mediæval ship of the Mediterranean, propelled primarily by oars. The Venetian galleys were about 160 feet long above, and 130 feet by the keel, 30 feet wide and 20 feet length of stern-post. They were furnished with three masts, and 30 banks of oars, each bank containing two oars, and every oar being managed by six or seven slaves, who were usually chained to it. In the fore part, after the invention of cannon, they had three small batteries of cannon, namely, two 36-pounders, two 24-pounders and two 2-pounders. They had also three 18-pounders on each quarter, and carried from 1,000 to 1,200 men.

The term galley, as applied to the ships of the ancient Greeks and Romans, refers especially to their warships, which were propelled chiefly by oars.

The Greek or Græco-Etruscan vases show many illustrations of biremes, that is, galleys with two banks, or longitudinal rows, of oars. The invention of this form of vessel was a very important advance in naval construction, for it permitted of a large increase in rowing-power, in proportion to the bulk and weight of the vessel. It was the trireme, however, which formed the chief warship of Greece during her prime. It had three banks of oars on each side. The seats for the rowers, which were removable, were placed between the sides of the vessel and a series of upright and inclined timbers supporting the main deck. The stem of the vessel was generally curved, and terminated in an ornamental figure-head, and the stern-post was also usually curved upward and finished off ornamentally. At the stern there was an elevated quarter-deck whence the helmsman and the trierarch or naval captain gave orders. The latter had full command of the ship; the former acted as navigating officer, having the oarsmen and sailors under his command. The trireme had regularly two masts — a mainmast with one large sail, and a very small foremast.

The rowers formed much the largest portion of the crew, while an Attic trireme carried also 10 marines, 17 sailors, a sort of paymaster, two men in charge of the lines of towers, besides two boatswains, one with a flute, to give the time to the rowers. The total crew would thus be about 220. The total length of a trireme was about 120 feet, of which about 100 was devoted to the rowers; the breadth at the water-line was some 12 feet; and the draught about 6 feet. A speed of 8 or 9 knots was probably about the highest obtainable.

The Romans did not become important as a maritime nation till the period of their struggle with Carthage. They built large numbers of ships, chiefly of higher rates than the trireme. But the triumph of the bireme vessels, known as Liburnian galleys, at Actium led the way for a reversion to lower-rated ships. Consult Parker, F. A., 'Fleets of the World: The Galley Period' (New York 1876); Chatterton, E. K., 'Sailing Ships and their Story' (London 1900); and 'Ships and Ways of Other Days' (Philadelphia 1913); Holmes, G. C. V., 'Ancient and Modern Ships' (2 vols., London 1906).

GALLI, găl'ī, the emasculated priests of Cybele, who was worshipped as symbolizing the procreative powers of nature. Cybele was the «Great Mother» and inspired the arts of agriculture. The chief seat of this cult in historic times was Pessinus in Galatia, but it never obtained public recognition in Greece, where the excesses and mendicity of its priests exposed it to contempt. It was introduced into Rome 204 B.C., at the bidding of the Sibylline oracle, and for the purpose of expelling Hannibal from Italy. The Galli were permitted to pass in a procession through the streets of the city, led by an Asiatic priest and priestess, but Roman citizens were forbidden to participate in this service. The cult gained an increasing favor and popularity and in the 2d century A.D. other rites were added, such as baptism in the blood of bulls and rams, by which the devotee was supposed to be cleansed from pollution and regenerated. This baptism was undergone by the Emperor Julian, called the Apostate. The worship of Cybele was checked by Constantine and abolished by Theodosius.

GALLIC ACID, $C_6H_2(OH)_3COOH$, is an acid which exists in small quantity in gall-nuts, in valonia (the acorn-cup of *Quercus ægilops*), in dividivi (the pod of *Cæsalpinia coriaria*), in sumach, and other vegetables. It is usually prepared from gall-nuts, which, in addition to gallic acid, contain a large proportion of tannin (tannic acid or gallo-tannic acid). When the gall-nuts are digested with water for some weeks fermentation takes place, and the tannic acid is gradually converted into gallic acid. The same result is obtained more quickly if sulphuric acid be present. To obtain pure gallic acid the gall-nuts are boiled with water, and the hot liquor separated. On cooling gallic acid crystallizes out, and is further purified by solution in hot water and treatment with animal charcoal. It forms delicate, silky, acicular crystals, nearly colorless and having a sourish taste. It is soluble in three parts of boiling water, but only in 100 of cold water, and on this account it can be readily purified by recrystallization. With solution of iron salts (ferric) it produces a blue-black color, and finally yields a black precipitate on exposure to the air. Hence it may be used in the production of ink, for which purpose it has some advantages over tannin or gall-nuts. When the crystals are strongly heated pyrogallic acid ($C_6H_3(OH)_3$) is produced and sublimes over. Gallic acid is a useful astringent. As it does not coagulate albumen it is readily absorbed into the blood, and in this way it is efficacious in Bright's disease. Where a decided local astringent effect is desired tannic acid is much more powerful. It has been used in excessive sweating and is useful for sweating feet and as a local spray and gargle in tonsilitis, pharyngitis and similar affections of the nose and throat.

GALLIC WAR, Cæsar's Commentaries on the. Cæsar had filled the consulship in the year 59 B.C. Shortly after the end of his year of office, he had set out (early in 58 B.C.) for the province of trans-Alpine Gaul, to which he had been appointed for a period of five years. The situation in this province was most serious. Various wild tribes were becoming restless and were threatening the fringe of Roman cities scattered along the Mediterranean in southern Gaul. Appreciating the menace to Roman interests and Roman prestige, Cæsar gathered troops to meet the immediate crisis. The Gallic tribes, suspicious of Cæsar's first success, soon began organized resistance to his evident purposes of ambition, and in the attempt to maintain their freedom and realize their national aspirations waged campaign after campaign against the Romans. Despite their gallant efforts they were finally crushed in the year 52 B.C., when with the surrender of Vercingetorix and the fall of Alesia, the last attempts at Gallic independence were proved futile.

Cæsar's Commentaries on the Gallic War give an account of the events of his contest with the Gallic tribes. This account is contained in seven books, each book being devoted to the campaigns of a year. The struggle lasted from 58 to 52 B.C. The work seems to have been published in the winter of 52 to 51 B.C. Book I deals with the unsuccessful attempt of the Helvetians to invade southern Gaul; also with the defeat of the Germans under Ariovistus, who had established a tyranny over the Sequani and Haedui in eastern Gaul and was now threatening Roman influence in this region. Book II is devoted to an account of the overthrow of the Belgian league. To forestall the establishment of Roman ascendancy in northern Gaul, the Belgian tribes had organized a strong confederacy. One of these tribes, the powerful and warlike Nervii, almost succeeded in inflicting a crushing defeat on Cæsar's troops in a fierce engagement on the Sambre. Book III embraces a description of the successful maritime war against the Veneti and their allies on the northwestern coast of Gaul, along with the account of scattered operations by Cæsar's lieutenants in other quarters. Book IV deals first with the campaign against the Germans. This was waged partly to the west, partly to the east, of the Rhine. To cross the river, Cæsar (in 10 days) constructed his famous bridge. He then penetrated far into the interior of the country. The remainder of Book IV describes Cæsar's first invasion of Britain in the autumn of 55 B.C. Book V begins with the events connected with the second invasion of Britain and gives an interesting description (chapters 12–14) of the island and its inhabitants. The concluding portion of the book is devoted to an account of the overthrow of the new league of Gallic states against the Romans. Book VI describes a second expedition into Germany. In this connection a somewhat lengthy account of German institutions and customs is given and a contrast drawn between the Germans and the Gauls (chapters 11–28). The year 52 B.C. was signalized by a general revolt of all the Gallic tribes against the Roman rule. The leader in this movement was the able, courageous and patriotic king of the Arverni, Vercingetorix. The struggle was futile. Alesia, Vercingetorix's stronghold, was captured, his forces crushed, and he himself taken as a prisoner to Rome. These operations are described in Book VII. An eighth book, detailing the Gallic operations of 51 B.C., has come down to us. It was written by Hirtius, one of Cæsar's lieutenants.

The importance of the Commentaries lies partly in the subject matter, partly in the authorship. They are the composition of a great personality, dealing not merely with great events, but events of world-historic import of which he himself was the directing genius. Cæsar's account in the main is authentic and trustworthy. By always speaking of himself in the third person, he aims to produce the impression of detachment and impartiality. Yet at times he suppresses the truth, and at times colors his narrative in his own favor. Specific literary charm, as ordinarily understood, is totally lacking. Cæsar's simplicity and directness have always appealed to his readers, but the composition of the work was evidently hasty. Much of it may have even been the unrevised draft of notes made at the time of the events described.

Translation: T. Rice Holmes (London 1905). A scholarly discussion of the contents of the work may be found in the same writer's 'Cæsar's Conquest of Gaul' (Oxford 1911).

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GALLICAN CHURCH. See GALLICANISM.

GALLICAN CONFESSION, The, or French Confession of Faith, was prepared by John Calvin and his pupil De Chandieu and approved by the Synod of Paris in 1559. In 1561 it was delivered by Theodore Beza to Charles IX at Poissy. In 1571 it was formally adopted by the Synod of La Rochelle, and due to that fact is sometimes called the "Confession of Rochelle." It was also sanctioned by Henry IV. It consists of an address to the king and 40 articles. The text of the articles may be found in 'The Creeds of Christendom' by Philip Schaff (Vol. III, pp. 356–382, New York 1877). The arrangement is the same as in Calvin's 'Institutes' and the Geneva Catechism of 1540. In 1848 an attempt was made to substitute a new confession but failed. In 1872, however, a second attempt proved successful but created a division in the Church.

GALLICANISM, the tendencies, principles, or action of those members of the Roman Catholic Church in France who, notably in 1682, sought to increase the power of the national church and to restrict in that country the authority of the Pope. By extension, the tendency to enlarge the prerogatives of any national Church in restriction of the authority of the Roman See. This term takes its derivation from the controversies between the French monarchy at various times and the Roman pontiffs in regard to ecclesiastical jurisdiction. It is a mistake to suppose that Gallicanism took its rise in France prior to the 13th century, or that the decrees of Louis IX, including the Pragmatic Sanction, were in any proper sense an attempt to restrict the authority of the Roman pontiffs. So far from this being true, their object was to assure the immunities and franchises accorded to the clergy from the exactions of the royal officers and feudal lords. In his ordinance of April 1228, Louis IX, or rather his mother, Blanche of Castile, the regent, says not a word about the relations of the clergy or the laity with the Roman pontiff, and Pope Innocent IV, in 1250, in a letter to the queen, thanks her for issuing it.

It was not until the time of Philip the Fair that Gallicanism in any proper sense can be said to have manifested itself. That monarch in his contest with the papacy sowed the seeds of the controversy as to the question of papal jurisdiction, which so long agitated the French Church. As a result of his contest with Boniface VIII, and of the later declarations of the Councils of Constance and Basel, the principles began to be enunciated by the national party; one that the king of France was absolutely independent of the Pope in all temporal matters; the other, that the papal power was not absolute, must be exercised within the limits of the canons, and was inferior to that of a general council. By the Pragmatic Sanction passed at Bourges in 1438, the Gallican Church, in union with the king, adopted the decrees of the Council of Basel abolishing papal reservations and expectatives, and restricting appeals to Rome to the *causæ majores*. Against this many popes protested, but it was not until the date of the concordat (1516) between Leo X and Francis I, that it was abolished.

During the 16th century there were many customs and privileges of more or less ancient date still extant, which the national party delighted to call "Gallican liberties." The crisis came in the 17th century, during the reign of Louis XIV, over the question of the royal right of regalia. Two bishops excommunicated the crown nominees to benefices in their dioceses. Their Metropolitans canceled their sentences; whereupon they made appeal to Rome, and the Pope annulled the decisions of the Metropolitans. The Crown resented the Pope's decision as an intrusion upon its rights. Louis XIV called an assembly of French bishops (1682) to confirm his position. This assembly formulated the famous Four Articles setting forth the "Gallican liberties." The first declared that the jurisdiction of Peter's successor did not extend to civil and temporal affairs, that kings were subject to no ecclesiastical power in temporals, and denied the deposing power of the popes. The second ratifies the third and fourth sessions of the Council of Constance as regards the respective authority of the Pope and general councils, and denies that these sessions refer only to times of schism. The third asserts the validity of the laws, customs and constitutions of the realm and of the Gallican Church. The fourth declares that although the Pope has the principal share in questions of faith, and that his decrees regard all and particular churches, still his judgment is not irreformable, unless the consent of the Church be added.

Afterward, at the command of the king, who subsequently realized the radical character of the Four Articles, the bishops who had signed them individually wrote to the Pope retracting their *Declaration*. Later Louis himself wrote to Innocent XII, in 1693, stating that he had "given the necessary orders to the effect that the contents of my edict of 22 March 1682, concerning the *Declaration* emitted by the clergy of France, be not observed."

Nevertheless, the spirit of Gallicanism lingered on in France, finding fresh impetus in Jansenism. During the 18th century its strength rapidly waned, and by the time of the French Revolution (1789) it had ceased to have any vital significance. Consult Jervis, W. H. P., 'The Church of France' (2 vols., London 1872) and 'The Gallican Church and the Revolution' (ib. 1882); Le Roy, 'Le Gallicanisme au XVIII siècle' (Paris 1892); Valois, P. N., 'La France et la grand schisme de l'Occident' (4 vols., Paris 1896–1902); Sabatier, P., 'France To-Day: its Religious Orientation' (New York 1913).

GALLICO, Paolo, American pianist: b. Trieste, Austria, 1868. At the Vienna Conservatory of Music he studied under Julius Epstein and there won two firsts for piano playing. Next he toured the principal countries of Europe, giving concerts in all the principal music centres. He visited the United States in 1892 and thereafter made his abode in New York, where he became a noted teacher of piano. He has composed several songs and pieces for piano and has appeared frequently at recitals and as soloist with orchestras.

GALLIENI, gäl-lē-ä'nē, **Joseph Simon,** French general and colonial administrator: b. Saint-Béat, Department of Haute-Garonne, 24 April 1849; d. Versailles, 27 May 1916. The son of an officer, he was educated at the military college of Saint Cyr and served as lieutenant in the Franco-German War. From 1877 to 1881 he served in West Africa in military, scientific and administrative capacities. With General Faidherbe, his chief, he was mainly instrumental in founding French Equatorial Africa. Being sent on a mission to a savage chief, Ahmadou, in the interior, he was held prisoner for ten months and informed every morning that he was to die that day. Gallieni finally succeeded in concluding a treaty with his captor. He next served three years in Martinique and in 1886 became governor of Upper Senegal. He was sent to Indo-China (Tonquin) in 1893 and fought for two years against the Black Hand pirates. In 1896, when Madagascar (q.v.) became a French colony, he was appointed governor and commander-in-chief. His vigorous and determined policy made a great improvement in the condition of the island. He first crushed rebellion and brigandage, and then pursued a policy of enlightened pacification. His efforts were so successful that the young women of Tananarivo were soon wearing Paris fashions and learning French dancing. When Gallieni laid down his office in 1905 he left a peaceful and prosperous colony. On his return to France he became military governor of Lyons, and in 1908 a member of the Supreme War Council. In the dark days of August 1914, when the German armies were pouring in like an irresistible avalanche upon Paris, that city was not in a position to defend itself. On the 26th Gallieni was placed in command of the entrenched camp, of Paris. A new spirit of courage and energy entered with him. Great gangs of laborers left the city every morning in "sight-seeing" cars to throw up hasty trench defenses; the arrival of naval guns and numerous other indications showed that Gallieni was preparing to defend Paris inch by inch if necessary. But the decisive battle of the Marne saved the city. On 29th Oct. 1915 Gallieni became Minister for War in the newly-formed Briand Cabinet. In March 1916 his health broke down and he retired. He was replaced by Gen. Pierre Roques. An accomplished scholar and linguist, Gallieni was a member of various learned societies and published several volumes on the Sudan and Madagascar. See MADAGASCAR.

GALLIENUS, găl-ĭ-ē'nŭs, **Publius Licinius Valerianus,** Roman emperor: d. 268 A.D. He received the title of Cæsar from the senate at the same time with his father, Valerianus, and associated with the latter in the empire on his accession in 253 A.D. His father having been defeated and taken prisoner by Sapor, king of the Persians, in 260, Gallienus showed complete indifference, and continued to reign alone without making any attempt to deliver his father. With a like indifference he saw his empire dismembered by numerous usurpers, and invaded in all parts by barbarians.

GALLIFFET, gä-lē-fā, **Gaston Alexandre Auguste,** MARQUIS DE (PRINCE DE MARTIGUES), French general: b. Paris, France, 23 Jan. 1830; d. there, 8 July 1909. He joined the army in 1848, serving in the Crimea, Mexico and Algeria. He took part with the Army of the Rhine during the Franco-German War, being made prisoner at Sedan, after leading the memorable cavalry charge of the *chasseurs d'Afrique.* During the second siege of Paris he commanded a brigade of the Army of Versailles, and was unenviably distinguished for his severity to the Communard prisoners. He was promoted general of division in 1875, and was placed in command of the Ninth Army Corps in 1879 and of the 12th Army Corps in 1872. He became Minister of War in June 1899; he resigned in May 1900 after strongly supporting the government in the crisis following the Dreyfus affair.

GALLINÆ, a group of birds, styled gallinaceous or "game-birds," deriving its name from the Latin *gallus,* the domestic cock, which is a typical example. The group is non-classified as a suborder *Galli* of the order *Galliformes,* situated between the tinamous and the rails. The order embraces the singular mesites of Madagascar; the various partridges and quails of the Eastern Hemisphere *Tumices;* and the hoatzin besides the typical gallinaceous birds, which far outnumber the rest. All are ground-keeping, running birds, agreeing in the possession of a globular crop adapted to the digestion of the seeds and hard insects that form the greater part of their food, and in having the young hatched in such a state of advancement that they are clothed in a uniform coat of down-feather, and are able to run about and pick up food after a few hours. They are distributed throughout the world, but are most numerous and reach their highest perfection in the forested parts of the Orient. The group (*Galli*) includes the mound-birds or brush-turkeys, and other *Megapodes* of Australasia; the curassows and guans of tropical America; and all the pheasants, guinea-fowls, turkey, jungle-fowls (parents of our domestic fowls), tragopars, American quails and partridges, grouse, ptarmigan, and similar species of various parts of the world. Many have been successfully domesticated; others are prized as ornaments, or for their plumage, and all are good eating. Hence they have ever been the object of capture, and some of them afford the finest sport to be enjoyed with dog and shotgun. Special articles described the most important species under their popular names.

GALLINGER, Jacob H(arold)., American physician and Republican politician: b. Cornwall, Ontario, Canada, 28 March 1837, being one of 12 children; d. Franklin, N. H., 18 Aug. 1918. He received a common-school and academic education; was a printer in early life; studied medicine and was graduated in 1858; and followed the profession of medicine and surgery until he entered Congress. He was on the board of trustees of Columbia Hospital for Women, and a member of the board of visitors to Providence Hospital; was a member of the House of Representatives of New Hampshire in 1872, 1873 and 1891, and member of the constitutional convention in 1876; of the State Senate in 1878, 1879 and 1880, being president of that body the last two years. He was surgeon-general of New Hampshire, with the rank of brigadier-general, in 1879–80; received the honorary degree of A.M. from Dartmouth College in 1885; served as trustee of George Washington University for several years, and was chairman of the Republican State committee from 1882 to 1890, when he resigned the place, but was again elected to the position in 1898, and continued to serve until 1908, when he declined re-election; was chairman of the delegations from his State to the Republican national convention of 1888, 1900, 1904 and 1908; was for a time a member of the Republican national committee; was chairman of the Merchant Marine Commission of 1904–05, composed of five senators and five representatives in Congress; was a member of the National Forest Reservation Commission, and vice-chairman of the National Waterways Commission; served as president *pro tempore* of the Senate during a portion of the 42d Congress; was elected to the 49th and 50th Congresses, and declined renomination to the 51st Congress; was elected to the United States Senate, to succeed Hon. Henry W. Blair, for the term beginning 4 March 1891, and successively re-elected by the legislature without opposition in 1897, 1903, 1909; was re-elected by popular vote 3 Nov. 1914 for a fifth term.

GALLINULE. See MUD-HEN.

GALLIO, găl'ĭ-ō, **Lucius Junius Annæus,** Roman pro-consul of Achaia under Claudius when Saint Paul was at Corinth, 53 A.D. Born at Cordova, the son of the rhetorician Annæus Seneca and elder brother of the famous philosopher and statesman, Lucius Annæus Seneca, he procured his name by adoption into the family of Gallio the rhetorician. The narrative in the 'Acts of the Apostles' tells how, with regard to the clamor of the Jews against Paul, he was "not minded to be a judge of these matters" and how "Gallio cared for none of these things"; hence his name has become a synonym for a careless, easy-going, and indifferent man who keeps himself free from trouble and responsibility. Gallio's behavior, however, rather shows the impartial attitude of Roman officials, at that time, toward provincial religions.

GALLIPOLI, gäl-lēp'ō-lē, Turkey, a seaport on the peninsula of the same name, in the vilayet of Edirneh, in lat. 40° 24′ N. and long. 26° 39′ E., 130 miles west of Constantiople. The ancient Callipolis, of which some ruins remain, it was formerly the most important commercial town on the Hellespont, and still retains considerable trade. There are two harbors, extensive bazaars, and some manufactures. The town was taken by the Turks in 1354, and formed their earliest European possession; and here the allies disembarked during the Crimean War. Pop. about 30,000.

GALLIPOLI, Peninsula of, Turkey, a tongue of land separating the Hellespont from the Ægean Sea and the Gulf of Saros, about 55 miles long, by a varying breadth of from 4 to 13 miles. Lat. between 40° 3′ and 40° 38′ N., long. between 26° 10′ and 27° E. Its chief city is also called Gallipoli (q.v.). The western portion of this peninsula was the scene of desperate fighting in 1915. See WAR, EUROPEAN.

GALLIPOLI OIL, a coarse olive oil, used in Turkey-red dyeing and for other purposes, and prepared from olives grown in Calabria and Apulia, the latter being considered the best. The oil is conveyed in skins to Gallipoli, where it is clarified and shipped in casks.

GALLIPOLIS, găl-ĭ'pō-lēs, Ohio, city and county-seat of Gallia County; on the Ohio River, and on the Hocking Valley and Kanawha and Michigan railroads. It contains a United States Marine Hospital, Gallia Academy, the State Hospital for Epileptics, Washington High School, a library and park. Industries are iron and wood manufactures, etc. First settled in 1790, Gallipolis was incorporated as a village in 1842 and chartered as a city in 1865. Pop. 5,560.

GALLITZIN, Demetrius Augustine, PRINCE, American clergyman: b. The Hague, 22 Dec. 1770; d. Loretto, Pa., 6 May 1840. He was a son of Prince Dimitri Gallitzin, and became a Roman Catholic in his 17th year. He served with Austria against France in 1792. He was ordained a priest in the United States in 1795, and after preaching at Port Tobacco, Canewago and Baltimore, betook himself to a bleak region among the Alleghany Mountains in Pennsylvania, where he was known as «Father Smith.» Here he laid the foundation of a town called Loretto. He declined to return to Russia on his father's death, and as a Catholic priest, was adjudged to have lost his right of inheritance. He was for some years vicar-general of the diocese of Philadelphia. He was austere in his mode of life, but liberal in the highest degree to others, and an affectionate and indefatigable pastor. In 1809 he resumed his original name. He wrote various controversial works, including a ‹Defense of Catholic Principles› (1816); ‹Letter to a Protestant Friend› (1820), and ‹Appeal to the Protestant Public› (1834). Consult Heyden, ‹Life and Character of Rev. Prince Demetrius A. de Gallitzin› (Baltimore 1869).

GALLIUM, a metallic element, symbol Ga, atomic weight 69.9. Gallium is a triad element. Specific heat 0.079. It was discovered by the French chemist, Lecoq de Boisbaudran, by means of the spectroscope; but the Russian chemist Mendeléeff had shown in his periodic law (q.v.) that an element must exist having intermediate properties between aluminum and indium. He called his supposed element eka-luminum. The metal is obtained by dissolving the blende in sulphuric acid and placing in the solution plates of zinc. This precipitates antimony, arsenic, bismuth, copper, cadmium, etc., while gallium, aluminum, iron, zinc, etc., remain in solution, and after solution and precipitation basic salts of gallium are thrown down by zinc. The metal is then isolated by electrolysis. Gallium is a hard metal, very slightly malleable and leaves a bluish-gray trace on paper; when melted it adheres to glass; it does not tarnish in the air. Its specific gravity is 5.95. It melts at 30.15° C. It gives two brilliant violet lines in the spectrum. When heated in the air it oxidizes on the surface, and does not volatilize. It dissolves in hydrochloric acid with disengagement of hydrogen. It is scarcely attacked by nitric acid in the cold; when heated it dissolves slowly with evolution of nitrous fumes.

At least one oxide, two chlorides, and iodide, a bromide, a nitrate, a sulphate, a double sulphate with ammonium and probably a hydroxide are known. The chief means of detecting gallium is by its spectrum.

GALLIUM CHLORIDE, in chemistry, $Ga\,Cl_3$. It is colorless, crystalline and deliquescent.

GALLIUM SALTS, salts precipitated by ammonia. If redissolved by hydrochloric acid, and again precipitated by ammonia, the precipitate is soluble in excess. If zinc is present the gallium is precipitated along with the zinc. Potassium ferrocyanide gives a yellow precipitate with strongly acid solutions of gallium chloride.

GALLON. See WEIGHTS AND MEASURES.

GALLOTANNIC ACID. See TANNINS.

GALLOWAY, Beverly Thomas, American horticulturist and plant pathologist: b. Millersburg, Mo., 16 Oct. 1863. He was graduated from the University of Missouri, agricultural course, in 1884; was assistant in the horticultural department of the university in 1884–86, and chief of divisions in the United States Department of Agriculture, division of vegetable physiology and pathology, in 1887–88. In 1900 he became chief of the Bureau of Plant Industry and served in this capacity until 1913, when he was appointed assistant secretary of agriculture. In 1914 he was made dean of the College of Agriculture at Cornell University. His writings include works on plant diseases, botany, horticulture, rural education and allied subjects.

GALLOWAY, Charles Betts, American bishop of the Methodist Episcopal Church, South: b. Kosciusko, Miss., 1 Sept. 1849; d. 12 May 1909. In 1868 he entered the Mississippi conference and for several years he was pastor of various churches in that State. From 1882 until 1886 he was editor of the New Orleans *Christian Advocate*, and in the latter year was made bishop. He was also elected president of the board of education of his church, and published a 'Life of Bishop Linus Parker'; 'Handbook of Prohibition'; 'Open Letters on Prohibition,' written during his controversy with Jefferson Davis on prohibition, of which he was an earnest advocate; 'Modern Missions: Their Evidential Value'; and 'Christianity and the American Commonwealth.'

GALLOWAY, Joseph, American lawyer: b. near West River, Md., about 1729; d. Hertfordshire, England, 29 Aug. 1803. He was admitted to the bar in Philadelphia, and was a member of the Pennsylvania Assembly 1757–74. He held a seat in the Congress of 1774, where he suggested a plan of government headed by a president-general to be appointed by the king and to hold office during the latter's pleasure, and a grand council elected every three years by the assemblies of the several colonies. Before the conclusion of the Revolutionary War he removed to England; and in 1788 was charged with high treason by the Assembly of Pennsylvania, which ordered his estates to be sold. He was the author of 'A Candid Examination of the Mutual Claims of Great Britain and the Colonies with a plan of Accommodation on Constitutional Principles' (1780); History and Political Reflections on the American Rebellion' (1780); etc. Consult Balch (ed.), 'Examination of Joseph Galloway by a Committee of the House of Commons' (1855); Tyler, 'Literary History of the American Revolution' (1897).

GALLOWAY, an extensive district in the southwest of Scotland, once somewhat larger, but now comprised in the shires of Wigtown and Kirkcudbright. To-day, the designation is nothing but a name, having no political bearing. It enjoys a mild climate, and is famous as a pastoral district, its breeds of small horses and of large, hornless, black cattle being well known. Dairy-farming is now an important industry. The old district or province is about 70 miles in length by 40 at its utmost breadth, and contains the greatest diversity of scenery — mountain, lake and stream, as well as dreary waste and almost pathless moor. There is no mineral wealth and few industries. The province owes its name to the fact that the natives were called Gall-Gael, or Foreign Gaels, at first because of their falling under the foreign rule of the Anglians; but as the Picts of Galloway they continued to be known so late as 1138. Their geographical position had shut them off from their northern kinsmen and they continued under their ancient names a distinct people till the 12th century, and preserved their language — a dialect of Gaelic — down to the 16th century, when it finally disappeared before the Reformation and the use of Lowland Scotch in the churches and schools, leaving only a rich crop of place names similar to those of Ireland and the Highlands of Scotland. The earliest inhabitants are styled by Ptolemy the *Novantæ* and their towns are given as Lucophibia, Perigonium, Corda and Carbantorigum. Tacitus tells us that Agricola concentrated a force in that part of Britain which looked on Ireland, and most authorities identify this with Galloway, and they are borne out by discovery of Roman forts in Wigtown. Galloway was subdued by the Northumbrian Anglians of Bernicia in the 7th century, and governed by them for about 200 years, and it was to this period apparently that the modern name is due. After about three centuries of more or less complete independence, interrupted only by Norse ravages and at length by a period of Norse supremacy, it was recovered by Malcolm Canmore, granted as an earldom in 1107, to his youngest son David, and on his accession to the throne in 1124, formally united with Scotland. Of the native lords of Galloway several rose in revolt in attempts to throw off the Scottish yoke, even offering fealty to England. Finallly in 1455 the lordship of Galloway was attached to the Crown. Consult Briggs, 'Angling and Art in Scotland' (New York 1908); Mackenzie, 'History of Galloway' (1841); M'Kerlie, 'Galloway in Ancient and Modern Times' (1891); Maxwell, 'History of Dumfries and Galloway' (Edinburgh 1900); Skene, 'Celtic Scotland' (ib. 1876).

GALLS AND GALL-MAKERS. Galls are unnatural plant-growths caused by various forms of parasitic animals or plants, more particularly by the hymenopterous family of gall-flies (*Cynipidæ*). Gall-gnats (*Cecidomyiidæ*),— (minute two-winged midges or flies), many species of mites, certain aphids, nematode worms, some forms of caterpillars, and the larvæ of weevils and other beetles also cause galls. Among plant gall parasites, the most important are bacteria, slime molds and certain algæ. The formation of a gall is due to the puncturing of any portion of a plant, the surface of the leaf, stem, roots or bark and the deposition of an egg in the cavity formed, or by the presence of larvæ subsequently hatched from it. Within

FIG. 1. — Bedeguar Gall of Wild Rose.

these excrescences the larvæ feed and grow, and either eat their way out while still grubs or remain till the pupa stage is past and emerge as adolescent insects. A gall may contain a single egg and larvæ or many, and both external form and internal structure vary widely. Each gall-fly has its favorite or exclusive host, and usually restricts its egg-laying to some special part of the plant. While most produce true galls, some members of the family utilize galls already formed.

The process of gall formation is but imperfectly understood. It is not known whether the gall-forming stimulus is mechanical or chemical in nature, nor whether it consists in the oviposition of the female or the growth and movements of the larvæ. The extreme complexity and specialization of the gall adds greatly to the difficulty of explanation. A cynipid oak gall may consist of an outer shell, with radiating fibres supporting a larval chamber with well developed food-layers, Not only is there a considerable increase in the number of cells, but their size is also often immensely greater than normal. The gall is often full of waste products, such as resins and tannic acid — whence comes their commercial value in tanning and in the manufacture of ink. Galls of closely related species may maintain a constant difference in structure. Many galls are hairy or spiny, while the plant is naturally smooth.

The reproductive relations of gall-flies are very interesting. In many cases parthenogenesis undoubtedly occur; in some species, for example, of *Rhodites,* no males have ever been found; in other forms the males when they occur are very few in proportion to the females. It must be emphasized that many gall-wasps

FIG. 2. — a, oak gall produced by *Cynips quercus-folii;* b, section of gall; c, gall-insect (*Cynips quercus-folii*).

distinguished by entomologists as separate species or even referred to different genera have turned out to be the parthenogenetic and the sexual forms of one species. A common life history is as follows: (a) Out of a summer-gall male and female forms emerge; (b) the females lay their fertilized eggs and give origin to winter-galls in so doing; (c) from these winter-galls there arise parthenogenetic females which in their egg-laying produce the summer-galls from which we started.

Galls vary greatly in shape, and may be solid or spongy, and contain one or several cavities, in each of which a larvæ is lodged. Though galls are very generally distributed, they occur in commerce chiefly as Levantine articles of trade. The Aleppo nut-galls are spherical and tubercular; blue, black and white varieties are recognized, the two former being picked before the escape of the larvæ, the latter after its exit. They are produced by a gall-fly (*Cynips gallætinctoriæ*) on twigs of an oak (*Quercus infectoria*). The galls made on oak by the common British «ash-fly» (*C. quercifolia*), or by the hundred or more American species of Cynips, might serve the purpose of ink making, tanning, etc., just as well; the 70 to 80 per cent of tannin they contain is the principal element of value. Dead Sea Apples, or Mecca or Bussorah galls, or Apples of Sodom (*mala insana, or C. q. infectoriæ insana*), are varieties of this vegetable product. The artichoke or strobile galls consist of several pieces, and resemble the fruit (strobilus) of the hop. They are exemplified by the gall produced on the willow by a *Cecidomyia.* The hairy galls, or bedeguars, or rose sponges, are chiefly found on *Rosa rubiginosa;* they are produced by *Rhodites rosæ.* A peculiar fact about many galls is that they contain insects other than those which have caused them. These are called inquilines. They are often, but not always, closely related to true gall-forming insects. Consult Adler, H., 'Alternating Generations: A Biological Study of Oak Galls and Gall Flies' (Oxford 1894); Beutenmüller, 'The Insect-Galls of the Vicinity of New York City' (*American Museum Journal,* Vol. IV, New York 1904); Kuster, E., 'Die Gallen der Pflanzen' (Leipzig 1911).

GALLUP, N. M., a city on the Atchison, Topeka and Sante Fe Railroad; in McKinley County in the western part of the State. Several large coal mines are in the vicinity and also two brick works. There is an auto road to Pueblo of Zuni 35 miles south and to Ganado, Saint Michaels and Fort Defiance to northwest. The city has extensive trade with Navajo Indians who have a reservation not far north. There are large supplies of water from artesian wells. Pop. about 2,500.

GALLUS, sometimes mentioned as Saint Gal, Saint Gilian or Saint Gall: b. Ireland about 560; d. at the monastery of Saint Gall, Switzerland, 16 Oct. 646. He is known to have been a disciple of Columban. With a few companions, he established the hermitage of Saint Gallus in 613 which later became a noted monastery. An account of his life appeared in the 8th century but is so filled with legends as to make it seem without authority. He is said to have seldom left his cell. The monastery had a continuous and eventful career until 1805 when it was suppressed. The buildings were used as a spinning factory from 1801–08. The wonderful collection of manuscripts numbering over 80,000 is still in the town.

GALLUS, Caius Cornelius, Roman poet: general and administrator: b. Forum Julii (modern Fréjus), in southeastern Gaul, about 66 B.C.; d. 26 B.C. He was educated at Rome, where he became an intimate friend of Virgil, Varus and Asinius Pollio. After the assassination of Julius Cæsar, Gallus joined the party of Octavius (afterward Augustus), by whom he was appointed to assign lands in northern Italy to army veterans. He commanded a division at Actium, and in Egypt defeated the forces of Antonius and captured Cleopatra. When Cleopatra died (30 B.C.), Gallus became the first governor of the Roman province of Egypt, which he administered with considerable success for four years. Then charges against him were laid before Augustus, and, deprived of rank and estates and sentenced to banishment, he killed himself by falling on his sword. Gallus, who imitated the Greek Euphorion, is regarded as the founder of the Roman eligy, and by Ovid is given first place among the elegiac poets of Rome. He wrote four books of elegies chiefly on his mistress, a notorious actress named Cytheris, whom he called Lycoris. Little or nothing of his verse has survived. He is introduced in the well-known story of Roman domestic life, entitled 'Gallus: Roman Scenes from the Time of Augustus,' by W. A. Becker (Eng. trans., London 1844; 9th ed., 1888). Consult Nicholas, A., 'De la vie et des ouvrages de C. Gallus' (Paris 1851); Mackail, J. W., «Virgil and Virgilianism» (in 'Lectures on Poetry,' London 1911); Smith, K. F., 'The Elegies of Albius Tibullus' (New York 1913).

GALOIS, găl'wä', **Evariste**, French mathematician: b. Bourg-la-Reine, 25 Oct. 1811; d. Paris, 31 May 1832. He obtained his early education in the Collège de Louis-le-Grand and entered the Ecole Normale in 1830, while there writing a theorem on the solubility of irreducible equations of prime degree by radicals, six articles on the theory of equations and theory of numbers, and with others founded the theories of groups and functions. His works were published in Paris under the auspices of Le Société Mathématique de France (1897). See EQUATIONS, GALOIS THEORY OF.

GALOPARO, gäl-ō-pä'rō, an agitated body of water off Capo del Faro, the Charybdis (q.v.) of the ancients. It forms the whirlpool on the outside of the harbor of Messina, in the strait separating Italy from Sicily. Opposite, on the Italian coast, is the rock Scylla.

GALSWORTHY, John, English author: b. 1867. His early works appeared under the *nom-de-plume* of "John Senjohn" and attracted little notice, being purely of a conventional type. 'Jocelyn' (1898), 'Villa Rubein' (1900) and 'A Man of Devon' (1901), all belong to this period. His later novels and plays departed from the conventional and are more individual, more serious and vastly more interesting, because of their dealing with acute social problems of the 20th century. Such are 'The Island Pharisees' (1904; 1908), a satire on British insularity and provincialism; 'The Man of Property' (1906), dealing with capitalism; 'The Country House' (1907), depicting English bourgeois types; 'Fraternity' (1909, German translation 1911), a study of class consciousness and solidarity; 'The Patrician' (1911); 'Moods, Songs and Doggerels' (1911); 'The Inn of Tranquillity' (1911); 'The Dark Flower' (1913); 'The Little Man and Other Satires' (1915); and 'The Freelands' (1915). His plays present social problems even more strongly than his novels. Of these the most important are 'The Silver Box' (1906), showing the all too frequent legal differentiation between rich and poor; 'Joy' (1907); 'Strife' (1909), the story of a strike; 'Justice' (1910), a play of prison life; 'The Little Dream' (1911); 'The Pigeon' (1912, produced in New York in 1913), a problem in poverty; 'The Eldest Son' (1912); 'The Fugitive' (1913); 'The Mob' (1914); 'The Foundation' (1917); 'Beyond' (1917). Galsworthy was included in the king's New Years honors (1918) for a knighthood which he declined. (See JUSTICE). Consult Skemp, A. R., 'Plays of John Galsworthy,' in 'Essays and Studies by Members of the English Association' (Vol. IV, London 1914).

GALT, gâlt, SIR **Alexander Tilloch**, Canadian statesman: b. London, England, 6 Sept. 1817; d. Montreal, 19 Sept. 1893. He was a son of John Galt (q.v.) and went to Canada while still a boy. He was closely identified with the Eastern Townships; was first elected to the Canadian legislature in 1849; was Minister of Finance 1858–62, 1864–66 and in 1867; and Canadian High Commissioner to England from 1880–83. He was the first to bring Confederation within the range of practical politics, and he stoutly claimed for Canada the right to determine her own fiscal policy. His budget of 1859, embodying as it did his policy of incidental protection, was inconsistent with the treaty of reciprocity then subsisting between Canada and the United States, and helped to put a period to the agreement. He was created K. C. M. G. in 1869, and was one of the fisheries compensation commissioners under the Washington Treaty of 1871.

GALT, John, Scottish novelist: b. Irvine, Ayrshire, 2 May 1779; d. Greenock, Scotland, 11 April 1839. In 1804 he went to London, and entered into a mercantile partnership, but the venture soon ended in bankruptcy. He then entered himself at Lincoln's Inn, but made small progress in law, and quitted England in 1809. He made a tour of the south of Europe and the Levant, and on his return in 1812 published 'Voyages and Travels in the Years 1809, 1810 and 1811,' and in 1813 'Letters from the Levant.' In 1812 he had published 'Life of Cardinal Wolsey,' and also a volume of tragedies, which received a rough handling from the *Quarterly Review*. In 1820 and 1821 the 'Ayrshire Legatees,' a series of letters descriptive of a supposed visit by a Scottish minister's family to London, appeared in *Blackwood's Magazine*, and attracted universal attention. Its success induced him to publish immediately afterward his 'Annals of the Parish,' which was received with no less approbation. 'The Provost,' 'The Steamboat,' 'Sir Andrew Wyllie' and 'The Entail' appeared in rapid succession. These were all extremely popular, but his subsequent novels, 'Ringhan Gilhaize,' 'The Spaewife' and 'Rothelan,' did not sustain the reputation which he had acquired. 'The Omen' (1825), which was praised by Scott, was followed by 'The Last of the Lairds' (1826). In 1826–29 he was superintendent to the Canada Company. While in Canada he founded the town of Guelph (1827). After his return to England he produced many works, including 'Lawrie Todd' (1830), containing sketches of frontier life in America; 'Southennan'; 'Life of Lord Byron'; 'Autobiography of John Galt'; 'Literary Life and Miscellanies' in three volumes. Collected editions of his works were published in London (4 vols., 1868; 8 vols., 1899); the novels were edited by Meldrum (8 vols., London 1895–96).

GALT, Canada, town of Waterloo County, Ontario, on the Grand River, the Canadian P. and the Grand T. railways, 25 miles northwest of Hamilton; named for John Galt, the Scottish novelist (q.v). The town is picturesquely situated on both sides of the river which is here crossed by several bridges. It is substantially built and lighted by gas and electricity; an important jobbing centre; the seat of a United States consular agent; and has manufactories of flour, axes, paper, woolens, leather, foundry products, woodenware and paper. Between 1900 and 1910 its manufactures increased by nearly 140 per cent. Lumber, limestone and sand are in the neighborhood. An electric railway gives connection with Kitchener, Paris and Brantford. Pop. 10,299.

GALTON, gâl'tŏn, SIR **Francis**, English scientist: b. Birmingham, 16 Feb. 1822; d. 17 Jan. 1911. He was a grandson of Erasmus Darwin and a cousin of Charles Darwin, the scientist. He was educated at King Edward's School, Birmingham; studied medicine at the Birmingham Hospital and King's College, London; and graduated at Trinity College, Cambridge, in 1844. Having in 1846 traveled in North Africa, he explored in 1850 lands hitherto unknown in South Africa, publishing his experiences in his 'Narrative of an Explorer in Tropical South Africa' (1853), and in 'Art of Travel' (1855). His investigations in meteorology are recorded in 'Meteorographica' (1863). Later he specially devoted himself to the problem of heredity and anthropology. He is celebrated as the founder of the science of «eugenics» (q.v.), designed to improve the human family by discouraging and checking the propagation of the unfit and selective breeding among the fit, and he left his fortune to found a chair in that science in the University of London. Another subject that attracted him was identification by means of fingerprints; he devised a directory for that purpose; and practical application of his theories is now being made by the criminal authorities. Among his works are 'Hereditary Genius: its Laws and Consequences' (1869); 'Experiments in Pangenesis' (1871); 'English Men of Science: their Nature and Nurture' (1874); 'Life-History Album' (1884); 'Natural Inheritance' (1889); 'Finger Prints' (1893); 'Fingerprint Directory' (1895); 'Noteworthy Families' (1906); 'Memories of My Life' (1908); 'Essays in Eugenics' (1909). He was knighted in 1909.

GALUPPI, gä-loo'pē, **Baldassare**, Italian composer: b. island of Burano, near Venice, 18 Oct. 1706; d. Venice, 3 Jan. 1785. He was sometimes called «Il Buranello.» From 1722 he was an organist in Venetian churches, and he early wrote an opera, 'Gliamici rivali.' After study of advanced composition as a pupil of Antonio Lotti, he again turned to writing, and achieved notable success with more than 70 comic operas, among them 'Il mondo della luna,' and 'Il mondo alla rovescia.' He has generally been considered the originator of comic opera (opera buffa) in Italy. From 1741 he was for some time resident and active in London, in 1762 became maestro di capella at Saint Mark's and director of the Conservatorio degli Incurabili, and in 1765–68 was in Russia as court composer and director of music. Returning to Venice, he continued as director at the Incurabili. He wrote some sacred works, but none of his compositions are known to-day save a harpsichord sonata which finds place in Pauer's 'Alte Klaviermusik.' He is apostrophized by Browning in 'A Toccata of Galuppi's.' Consult Wotquenne, A., 'Baldassare Galuppi, étude bibliographique sur ses œuvres dramatiques' (Brussels 1901).

GALVANI, gäl-vä'nē, **Luigi**, Italian physiologist; the discoverer of galvanism: b. Bologna, 9 Sept. 1737; d. there, 4 Dec. 1798. He studied medicine, and in 1762 entered on the practice of his profession. His favorite studies were anatomy and physiology. He soon received the appointment of professor of anatomy in the celebrated university of his native city and published a treatise on the urinary organs of birds. While engaged in these pursuits he was fortuitously led to the discovery which has immortalized his name. It is related that his wife, the daughter of Galeazzi, a medical professor under whom he had studied, and a woman of superior intelligence, having observed that the contact of the inanimate body of a skinned frog with a scalpel lying on the table produced in the frog a series of remarkable muscular convulsions, the knife having been in contact with an electric machine, informed her husband of the fact, who instituted a series of experiments, and formed conclusions which led to a controversy with Volta. Galvani rightly ascribed the convulsive movements to electricity, but erroneously concluded that the electricity was generated by nerves and muscles. On a journey to Sinigaglia and Rimini he was so fortunate as to trace the cause of the electric appearances which are observed in the torpedo, and wrote a learned treatise on this subject. The loss of his beloved wife in 1790 rendered him inconsolable. Having refused to take the oaths to the Cisalpine Republic in 1797, he was deprived of his chair, and refused to resume it, when the government, in consideration of his celebrity, offered to allow him to do so unconditionally.

GALVANIC BATTERIES. See PRIMARY BATTERIES.

GALVANISM. See ELECTRICITY; GALVANIZATION, TREATMENT OF DISEASE BY.

GALVANIZATION, Treatment of Disease by. Of the different forms of electricity used in medicine the galvanic or direct current is perhaps the most widely employed. This form of current is derived from a primary battery, a storage battery, or a direct current dynamo. Its therapeutic use has a wide range: invigoration of the muscles; stimulation of the nutritive processes and of the secretory organs; allaying congestion; equalizing the blood pressure; elimination of morbid substance from the tissues; repulsion of bacterial attack; and sedative effects upon the nervous system. General galvanism is sometimes applied before a surgical operation to put the patient in a satisfactory state, and after the operation as a tonic measure, and also where the healing processes tend to produce local deformities. It may be administered either locally or centrally; local galvanization is used especially for the relief of pain. It is applied to the brain, eye, ear, sympathetic nervous system, spinal cord, urethra, bladder and chest, either by what is known as «stabile» application, in which both electrodes are kept in a fixed position, or by «labile» application, in which one or both electrodes are slid over the surface, but not lifted from the skin. It is found that a greater sedative influence is obtained if the galvanic current is not interrupted. Labile and stabile interrupted currents are generally preferred for the galvanization of muscles of the head, spinal cord and nerve-tracts. Stabile continuous currents, either uniform or increasing, give the best results. When the galvanic current is interrupted it causes, as is well known, pronounced muscular contraction. This is of service as a tonic to poorly nourished and atrophied muscles.

By «central» galvanization is meant that mode of treatment by the galvanic current by which the entire central nervous system may be brought under the influence of the electrical fluid. In order to accomplish this, one electrode, usually the negative, is placed over the solar plexus, at the pit of the stomach, while the other is firmly pressed to the top of the head and passed gradually over the back of the head and along the inner border of the strong muscle that pulls the neck to one side, the sternoclidomastoid. From here the electrode is passed down the spine. It is thought to increase the electrical excitability of the central nervous system, inducing sleep and relieving general tire. It is a method, however, that should be used with great caution, as it may do more harm than good. See ELECTROTHERAPEUTICS.

GALVANIZED IRON, sheets of iron coated with tin by a galvanic process, and with a second metal, zinc, which is effected by preparing a bath of fluid zinc covered with sal ammonia mixed with earthy matter. When the tin-coated sheet is plunged into this preparation the zinc is precipitated with a crystal-like diaper upon the tin. The term is sometimes improperly applied to sheets of iron which have been coated with zinc without recourse to the use of galvanism. The iron, after being thoroughly cleaned from all trace of oxydization, by a dilution of sulphuric acid, is then plunged into a bath of melted zinc and other substances such as sal ammoniac, or mercury and potassium.

GALVANOCAUTERY, the use of a cautery knife, loop, point or blade heated by the passage of a galvanic current. It is of value wherever a limited cautery action is desired, and particularly valuable in being easy to control. See ELECTROTHERAPEUTICS.

GALVANOMETER, an instrument for detecting and measuring the intensity, direction or length of duration of an electric current by means of the magnetic force it produces. The many types of indicating instruments such as voltmeters and ammeters, where the pointer is held at zero by some directive force, such as the earth's field, a spring or weight or a permanent magnet, come under this head. With very few exceptions, all galvanometers may be classed under two heads: (1) Those having a magnetized needle suspended so as to move freely in a horizontal plane, the needle being normally held at zero position by means of the earth's field or an external field produced by auxiliary magnets placed to accomplish this result. The needle is suspended on a pivot or a quartz fibre or fibre of silk or other appropriate material. (2) Those having a coil of wire in place of the needle in the first class. This is the type usually called the d'Arsonnal type, and has the coil suspended by means of a fine wire, which provides a way for leading current to the coil, and has another wire underneath the coil for conducting the current from it. The coil, with the conducting wires, is then suspended between the poles of a magnet, its axis being normally at right angles with the lines of the field. The second class of galvanometers, those having a moving coil, are to be preferred for most classes of work, all except those requiring the very greatest delicacy, for the following reasons: The readings are but very slightly affected by the presence of an external field or by magnetic substances in vicinity of the instrument, and are practically independent of the variable influence of the earth's field; this form of instrument may easily be made dead-beat (that is, when the coil is deflected it goes at once to its position without long vibration), on account of the strong field in which the coil moves; many forms are portable and much less affected by vibrations than those of the first class.

The figure of merit of a galvanometer may be expressed either as the current necessary to cause a deflection of one scale division, or as the resistance through which one volt will cause a deflection of one scale division when such resistance is inserted in the circuit. Such an expression of the delicacy of a galvanometer should be accompanied with the following data: The resistance of the instrument, the scale distance and size of one division of the scale. The sensitiveness of a galvanometer is expressed as the difference of potential across the galvanometer terminals necessary to cause a deflection of one scale division; and to be exact, should be accompanied with the same data as for the figure of merit. Of the moving needle class of galvanometers the tangent galvanometer and the Thomson astatic galvanometers are probably in most general use. The tangent galvanometer is constructed so that the inside diameter of the coil which surrounds the needle is at least 12 times the length of the needle. Under these conditions, the needle being held at zero by the earth's field, the current strength will vary directly as the tangents of the angle of deflection; hence the name of the instrument. Although at one time much used for the absolute determination of current strengths, it has of late been replaced by other types, on account of its many correction factors, some of which are of uncertain magnitude, a prolific cause of error being the necessity of knowing the exact value of the horizontal component of the earth's magnetism, which quantity is subject to continual change and is affected by large masses of iron or heavy electric currents in the vicinity. The sine galvanometer is similar but the coil is moved so as to bring the needle back to zero. This makes the sine of the angle through which the coil is moved proportional to the deflecting current.

The Thomson Galvanometer.— This type was designed by Lord Kelvin, and to him we are indebted for the most sensitive instruments as yet made. The moving system consists of a slender quartz rod to the centre of which is fastened a small mirror of glass which reflects a ray of light to a graduated scale. Above and below the mirror at each end of the quartz rod is fastened a complex of carefully selected magnetized needles, minute in size, placed parallel to the plane of the mirror. In the upper complex the north poles of the needles are all placed in one direction, and in the lower complex the north poles of the needles are placed in the opposite direction, the combination forming an astatic system, on which the earth's field exerts a very slight directive force. This directive force exerted by the earth's field would be zero if the two complexes could be made exactly equal in magnetic strength. Each complex of needles is enclosed by two coils, thus making four coils in an instrument. These coils are provided with binding posts for series or parallel connection, and are connected so that the current flowing through them will cause the magnetized needles to be deflected in the same direction in each complex. An adjustable magnet mounted on top of the instrument provides a directive action on the needles which may be modified to any extent, a weak directive force increasing the sensitiveness greatly, and also increases the period of oscillation, so that in the best instruments the sensitiveness is limited largely to the patience of the observer. Refinements of this type have eight coils and eight needles or groups of needles.

Moving Coil Galvanometers.— This type is most familiar in the d'Arsonnal galvanometers, and is to be preferred for most purposes within the limits of its sensitiveness. Its preference lies in the fact that it may easily be made deadbeat, and the readings are practically independent of the earth's field or magnetic substances in its vicinity. The construction also adapts itself to a portable type of instrument, and it may be so constructed as to be very slightly affected by vibrations. The sensitiveness of this class of galvanometers may be further increased by substituting an electro-magnetic field for that produced by permanent magnets.

Among the newer European galvanometers are the following: The Broca galvanometer is of the type having fixed coils and a moving magnetic system. Its distinctive feature is the form of this system, which consists of two steel wires hung vertically and close together. Each wire has like poles at its ends, making the system astatic. The Einthoven string galvanometer has a single fine wire or quartz fibre in the intense field of a powerful electromagnet having a narrow air gap. When a current flows through the string, the latter moves across the field. The motion is observed with a microscope or is registered by projecting the image of the string on a screen. This galvanometer has an extremely short period, as low as one one-hundredths of a second. It is highly sensitive and is free from inductance and capacity. The Duddell thermo-galvanometer has suspended in the field of a permanent magnet a loop of silver wire which is closed at the bottom by a thermo-couple of bismuth and antimony. The current to be measured is caused to flow through a heating coil placed below the thermo-couple. The heat sets up a current in the loop and deflects it more or less according to its strength. This galvanometer works equally well with either direct or alternating currents. It can be used with the wireless currents and for the telephone. Another type called the Duddell oscillograph is made for voltages up to 50,000 in either of two forms — with permanent magnet and with electromagnet. The former is preferred for the high-frequency currents and is more readily transported when necessary.

J. E. Taylor,
Western Electric Company, Philadelphia.

GALVANOSCOPE. See Electrical Terms.

GALVESTON, Tex., city, port of entry and county-seat of Galveston County, located on the east end of Galveston Island which is 30 miles long and two miles from the mainland. Galveston Bay lies to the north and Gulf of Mexico on the south. The city is connected with the mainland by the Galveston Causeway, an arched reinforced concrete structure, and used by electric interurban, steam railways, auto and vehicle traffic. It is on the Southern Pacific, the Missouri, Kansas and Texas, the Gulf, Colorado and Santa Fe, the International and Great Northern, the Galveston, Houston and Henderson, and the Gulf and Interstate railroads, and Galveston-Houston Electric Interurban. The city possesses a fine beach automobile speedway, 25 miles long. Semi-tropical winters and balmy summer breezes offer a delightful climate the entire year. The annual average temperature is 69°. Galveston has a magnificent gulf front, brick paved, brilliantly illuminated boulevard and walk, four and a half miles long and 17 feet above sea-level. It has two splendid bathing pavilions, pleasure and fishing piers, city-owned gulf front public park with free band concerts, boating, fishing and one of the finest and most up-to-date resort hotels in the country. Fishing is confined to no season. Tarpon, Jack fish, trout, Spanish mackerel, red fish, pompano and red snapper are freely caught at and near Galveston. The coast country in the vicinity of Galveston, during the fall and winter, is a hunter's paradise. The bays and creeks in this locality abound with ducks, geese and snipe. Miles of oleanders and palms line the streets. It is a city of beautiful residences and many conventions and large gatherings have been held here.

Public Buildings.— Galveston has a magnificent fireproof city auditorium, seating 4,200. The finest public library in the State, endowed with a fund of $535,000. The finest and best equipped public hospital in the South. A large Roman Catholic hospital, Y. M. C. A. building, a Masonic temple and Scottish Rite cathedral, Elks, Knights of Columbus and Eagles buildings. Galveston has 31 churches for white people and 12 churches for colored people, two orphan asylums, a home for homeless children and a home for aged women; the School of Medicine of the State University, 12 private or sectarian schools, a Roman Catholic University, two Roman Catholic academies, a business college and public high school and seven graded schools for white children. One high and two graded schools for colored children.

Docks and Terminals.— The city possesses 30 piers and berth room for 100 ocean-going vessels, coal elevators and floating bunker plants, fuel oil stations, 246 miles of standard gauge terminal tracks and 3,000,000 feet of covered storage space on water front. The Galveston Wharf Company in which the city owns a one-third interest has an improved channel frontage of 12,400 lineal feet and the Southern Pacific Terminal Company, 1,350 lineal feet. The city has 22,990 lineal feet of undeveloped channel frontage, a powerful wireless telegraph station, termini of the Mexican Telegraph Company, cable communication direct with Mexico and a United States quarantine station. There are commodious and modern immigration station and buildings. A United States revenue cutter is stationed at Galveston. The average yearly business passing over the Galveston docks is over $400,000,000. The export cargo in 1917 reached approximately $275,000,000. The facilities at Galveston for the proper storage of cotton are unequaled, there being ample space to store on end 913,500 bales. Galveston has a 10,000-ton dry dock and several ship repair plants. It has taken the national government 41 years and has cost $11,000,000 to develop the port of Galveston. It has a very large and impressively beautiful and well-fortified harbor, a channel six miles in length from open sea to docks, more than 32 feet of water on the bar with 35 feet on the inside, magnificent up-to-date system of docks, warehouses, compressers, fine grain elevators, railroad terminals and facilities and is well located with respect to the Panama Canal. Cars are unloaded and released on an average within one and a half days after arrival. Grain ships are loaded in one day.

Trade and Commerce.— Galveston is the natural entry port for the great Southwest. Its trade, particularly in cotton, places it among the foremost cities of the world in the volume and value of its exports and imports, as the figures will indicate. Galveston has advanced from third to second place in its rank among exporting ports of the United States. The total value of foreign exports for the trade year of 1917 was $275,000,000 and for 1916, $198,298,736. These figures place Galveston the fourth city in the United States in the volume of its foreign commerce. Galveston has over 50 lines of steamships to foreign ports, besides two regular lines of coastwise vessels to New York and points in the Gulf of Mexico. The domestic exports are cotton, wool, hides, oil cake and oil meal, cottonseed oil, fish oil, cement and poultry. The domestic imports are drugs, boots and shoes, hats, dry goods, chemicals and like commodities. The foreign exports are cotton, cottonseed oil, oil cake and meal, wheat, corn, flour, copper and iron ores, cattle, lumber and timber and provisions. The foreign imports include fire brick, tiles, chemicals, cement, liquors, earthenware, prepared vegetables and fancy woods. There are four export grain elevators, with a storage capacity of 4,000,000 bushels, and one clearing and conditioning elevator.

Government, Public Utilities, etc.— Galveston is governed by a mayor and four commissioners, known as the board of city commissioners. The commission plan was inaugurated by the city of Galveston, 18 Sept. 1901 and has proved highly satisfactory. The city owns Pelican Island, immediately across the channel from the city and with a channel frontage of 15,000 feet. On this island are located the dry dock and ship-repairing plants. It is susceptible of development into docks, warehouses and an ideal location for shipbuilding plants. The city owns four public parks. The waterworks, fire department, sewer system and street electric-light plants are owned by the city. The waterworks is valued at $2,000,000. The supply of water comes from artesian wells on the mainland and is piped under the bay. The city also owns a one-third interest in the Galveston Wharf Company and is represented on its board of nine directors by the mayor and two of the four city commissioners.

Finances and Industries.— The city has three State, four private and two national banks, 21 building, loan, abstract and real estate corporations. Two daily papers and six weekly papers are published here; 20 hotels, a large jobbing trade, brewery, cement and pipe works, ice plants, cold storage plants, iron works, sash, door and blind manufactories, cotton presses, clothing, flour, meal, coffee, baking powder, spices, extracts, pickles, preserves, macaroni and mineral water manufactories and rice mills, book manufacturing, lithographing and printing establishments.

Taxes and Assessments.—The assessed valuation of the city for 1918 was $43,000,000. The rate of taxation for the city on $100 valuation is $1.65, and for school purposes 25 cents additional. The public debt is $5,655,525.30, including grade raising bond issue.

History.—About the year 1782, a Spanish fleet made an examination of the coast of the Gulf of Mexico west of the Mississippi River, and named Galveston Bay and Island in honor of Conde de Galvez, then governor of Louisiana. The explorers found on the island one white man who subsisted by hunting and fishing. Galvez was governor of Louisiana from 1780 to 1785. Until the year 1816 Galveston Island remained in its primæval state, a low island formed in process of time by the sea throwing up sand and shells. The conjecture that La Salle visited Galveston Island during his brief stay in Texas is without reasonable foundation. The island was long a favorite hunting ground for the Caroñkawas, the once powerful and warlike tribe which inhabited so much of the coast of Texas. Francisco Xavier Mina, a young Spanish soldier, resolved to lend the patriotic cause in Mexico his sword and aid the people of that country in their struggle for liberty. He determined to make Galveston Island his base of operations. He worked in cooperation with Don Luis Aury, a naval officer. His plan was approved by Herrera, a commissioner of the Mexican revolutionary or Morelos government to the United States. Herrera, with Aury, landed on Galveston Island with an expedition in September 1816. A government was organized, Aury was made civil and military governor of Texas and Galveston Island and took the oath of fealty to the Republic of Mexico. In November 1816, Mina arrived at Galveston with a few small vessels and about 200 men. Mina and Aury abandoned the island in March 1817. Just about the time they left Galveston Island we have the first account of Lafitte coming to the island. The pirate is supposed to have reached Galveston late in 1816. He held letters of marque from the revolutionary government of Venezuela authorizing him to prey upon the commerce of Spain. He had a number of vessels and quite a force of adventurers. He also assumed to be governor of Texas under the revolutionary government of Mexico, probably having received some such authority from Herrera, the Mexican commissioner in New Orleans. Lafitte's purpose was to capture Spanish vessels sailing under the flag of the Mexican republic. By the close of the year 1817 the population of Galveston had increased to nearly 1,000. The United States and Spain found cause for complaint against the pirates, but Spain feared the United States would claim the island if the pirates were dispersed by the American naval establishment and the United States did not feel called upon to take action, owing to the attitude assumed by Spain, consequently Lafitte was left undisturbed. In 1820 an American vessel was taken by Lafitte's men. The United States government then dispatched an armed vessel under Lieutenant Kearney to break up the establishment at Galveston. Lafitte left Galveston for good, but continued his depredations upon Spanish shipping until 1826. In 1820 Dr. James Long visited Galveston Island to induce Lafitte, who was about leaving Galveston, to co-operate with him in the establishment of a government at Nacogdoches. Lafitte referred to the failure of all previous attempts to invade Texas and refused to join Long. Before Long left Bolivar Point a French sloop freighted with wine stranded on Galveston Island. Caroñkawas to the number of 200 were encamped in the vicinity. They attacked and butchered the crew, plundered the sloop and engaged in a drunken jollification. Long determined to chastise them. After nightfall with 30 men he passed over to the island in small boats. In the fight the Caroñkawas outnumbered the whites seven to one. Long was compelled to retreat. Three of his men were killed; 32 Indians were left dead on the field.

Little is heard of Galveston Island after Long's expedition until just previous to the battle of San Jacinto. The island was practically abandoned from 1820 until along in the thirties, when the Mexican government established a custom-house on the island. On the occasion of the preliminary meeting at Brazoria to declare the independence of Texas in 1835 there was no representitive present from Galveston. The same is true of the more formal declaration of independence which was made on 2 March 1836, at Washington on the Brazos. Just prior to the battle of San Jacinto the new Texas government retreated from Washington to Harrisburg. As Santa Anna and his army approached Harrisburg, President Burnet and his Cabinet sailed down to Galveston Island, narrowly escaping capture. The news of the victory at San Jacinto reached President Burnet on Galveston Island 26 April 1836. The provisional government of Texas under Governor Smith in 1835 had granted letters of marque and reprisal and had provided for the establishment of a small navy. The *Liberty*, one of the vessels of this navy, was at Galveston at the time of the battle of San Jacinto. Several prizes were taken by the Texas navy and brought into Galveston Bay. During the hostile period following the battle of San Jacinto the Mexican government proclaimed a blockade against the ports of Texas and in attempting to enforce it interfered with vessels of the United States. In 1837 the Texas navy was increased and several vessels were stationed at Galveston. The Third Congress of the Texas republic assembled at Houston in November 1838. The county of Galveston was represented for the first time in the third House of Representatives by Moseley Baker. After the annexation of Texas and the outbreak of the Mexican War the first Texas regiment to join General Taylor was composed of six months' men raised and organized in Galveston, commanded by Albert Sydney Johnston. Galveston County was created 15 May 1838. The battle of Galveston during the Civil War occured 1 Jan. 1863. The first railroad begun in Texas was at Harrisburg in 1852. The Galveston, Houston and Henderson road was begun at Virginia Point in 1855. Trains were first run from Virginia Point to Houston in 1859 and in that year a contract was let for the first Galveston Bay bridge, which was completed and trains were run into Galveston in 1860.

The jetties at Galveston were completed in 1896, since which time the water at the point where the bar existed has been slowly deepening. (See GALVESTON, JETTIES AT). Galveston wharves are only one hour from the deep sea for a laden steamer. Galveston wharf and terminal facilities, as a system, have few equals in the country, being excelled in no particular except size.

In December 1836, Col. Michael B. Menard purchased of the republic of Texas for the sum of $50,000 one league and labor of land on the east end of Galveston Island. He associated with him a number of persons and they formed a joint-stock company known as the Galveston City Company, which was incorporated in 1841. This company is still in existence, although its present holdings of real estate are not large. The city of Galveston was incorporated in 1839. The first mayor was John M. Allen.

Recent Civic Achievements.— The building of the causeway, connecting Galveston Island with the mainland, the building of the sea-wall and extension thereof and the raising of the grade of a large part of the city are three great achievements. On 8 Sept. 1900 Galveston was visited by a West Indian hurricane which did much damage to property and caused great loss of life. To guard against any such disaster in the future the city government secured the services of an engineering board composed of Gen. Henry M. Robert, Alfred Noble and H. C. Ripley, whose duty was to prepare plans looking to the protection of the city against storm damage. The county of Galveston assisted by the railroads constructed the great causeway. The county constructed the sea-wall and the United States extended same. The wall is 17,593 feet long, 16 feet wide at base and 17 feet high. (See GALVESTON SEA-WALL). The raising of the city grade was financed and carried out by the city with aid extended by the State, under the direction of a grade raising board, composed of J. P. Alvey, chairman; John Sealy and E. R. Cheesborough, secretary, appointed by the governor, S. W. T. Lanham. The total cost of the sea-wall and grade raising was $4,783,138.54, not including the cost of raising 2,156 buildings and other improvements aggregating $1,000,000 additional. The plan adopted in raising the grade of the city was not only remarkable in itself, but was one that called for great sacrifice on the part of the people. A canal, two and one-half miles long, 300 feet wide and 20 feet deep, was excavated from Galveston Bay through the residence section of the city. The people, for the mere payment of taxes, leased their land to the city and improvements were moved to vacant lots. Five self-loading, self-propelling and self-discharging hopper dredges were employed. Sand was sucked up from the bottom of the bay and brought in through the canal and discharged through pipe lines, the water draining back into the canal. The work completed, the canal was refilled and houses replaced. On 1 May 1918, actual construction started on the extension of the present sea-wall, looking to the protection of Fort San Jacinto, the eastern part of the channel of Galveston Bay and that part of the city area lying east of Sixth street, at the joint expense of Galveston County and the United States government, at a cost of $2,741,000, which includes fill to grade for 200 feet back of the wall, a sidewalk and brick driveway. The total length of this additional sea-wall is 10,300 feet. The sea-wall and grade raising have rendered Galveston absolutely safe from serious damage from the most violent storm that could possibly occur. According to the city directory Galveston's population in 1917 was 52,289.

E. R. CHEESBOROUGH,
President of the Galveston Commerical Association.

GALVESTON, Jetties at. The entrance to Galveston Harbor was originally obstructed by an inner bar upon which the depth of water was 9½ feet and an outer bar with a depth of 12 feet. The Federal government adopted the jetty system for improving the entrance to this harbor. Two jetties have been constructed of sandstone riprap and are covered with granite blocks weighing from 5 to 12 tons each. The south jetty is 35,603 feet in length and the north jetty 25,907 feet in length. They are built to a height of five feet above mean low tide and are from 12 to 15 feet in width at the top with a slope of about one and one-half feet to each vertical foot in depth. The distance between the shore ends of the jetties is about two miles; they converge until their sea ends are about 7,000 feet apart apart. The jetties, by confining the water, have increased the tidal scour and secured a depth of 30 feet at mean low tide on both bars. These works, damaged by the hurricane of 8 Sept. 1900, were repaired with granite blocks of 10 tons weight.

GALVESTON, Military and Naval Operations at. In the summer of 1862 Farragut sent several light squadrons to cruise along the coast of Texas, and a blockade was maintained against Galveston, which was abandoned by the Confederate military forces, and 8 October surrendered by its civil authorities to Commander Renshaw of the United States navy. Six United States vessels lay in the bay, commanding the city. Lieutenant Jouen, with two launches, captured and burned the privateer *Royal Yacht*, carrying one heavy gun, and took 13 prisoners, with a Union loss of two killed and seven wounded, 7 November. On 24 December 260 men of the 42d Massachusetts regiment were landed and encamped on the city wharf. At daybreak, 1 Jan. 1863, General Magruder, the Confederate commander in that department, made a combined naval and land attack upon the Union fleet in the bay and the military in the city. He secured four steamers from the adjacent rivers, used cotton-bales for armor, mounted them with guns and filled them with sharpshooters, and attacked the six United States vessels. The *Westfield* was blown up and destroyed by her officers to prevent capture; the *Harriet Lane* was boarded, and surrendered after her captain and executive officer had been killed. One of Magruder's boats went to the bottom in its encounter with the *Harriet Lane*. The land force was attacked by a largely superior force and, after a stout resistance, in which it had 20 men killed and wounded, surrendered. Magruder reported his loss as 26 killed and 117 wounded. The other United States vessels then abandoned the blockade, but Farragut quickly restored it. Soon afterward (11 January) a strange vessel was seen outside and the *Hatteras* was sent to overhaul her. She proved to be the noted *Alabama*, and after a short and hot fight she sunk the *Hatteras*, saving her crew. Ten days later the Union gunboats *Velocity* and *Morning Light*, blockading Sabine Pass, were attacked by Confederate steamers, driven out to sea, and captured, with guns, prisoners and a large amount of stores. Galveston remained in Confederate possession until the close of the war. Consult 'Official Records' (Vol. XV); Mahan, 'The Gulf and Inland Waters'; Maclay, 'History of the Navy' (Vol. II); Lossing, 'Field Book of the Civil War' (Vol. II); the Century Company's 'Battles and Leaders of the Civil War' (Vol. III).

GALVESTON BAY, an inlet of the Gulf of Mexico, extending northward from Galveston about 35 miles.

GALVESTON ISLAND, an island off the coast of Texas on the northeastern end of which is Galveston. Length, about 28 miles.

GALVESTON PLAN OF CITY GOVERNMENT. See COMMISSION FORM OF GOVERNMENT.

GALVESTON SEA-WALL. The date 8 Sept. 1900, in Galveston, Tex., will be referred to by its inhabitants for generations to come. The appalling loss of life and the destruction of property on that date, due to the terrific West Indian hurricane which drove the waters of the Gulf of Mexico over the oleander city, shocked the civilized world. Over 6,000 lives were sacrificed to satisfy the storm king's anger, and over $17,000,000 worth of property was completely destroyed. The city of Galveston is located on the east end of an island about 30 miles in length and from one to three miles in width. The entire south side of the island fronts on the Gulf of Mexico, while the north side fronts on Galveston Bay.

Why the Wall Was Built.— In September 1875 a hurricane swept over the island, causing considerable damage to property. At this time the convention was in session which framed the present constitution of the State of Texas. The impression produced by this hurricane led to the insertion of sections 7 and 8, in Article XI of the constitution, granting all counties and cities bordering on the coast of Mexico the right to issue bonds and construct sea-walls, or breakwaters. Judge Wm. P. Ballinger, one of Galveston's most honored citizens and a lawyer of marked ability, was a member of this Constitutional Convention, and the author of the sections before named. On 28 Aug. 1886 Judge Ballinger addressed an open letter to the citizens of Galveston, calling to their attention this constitutional provision and warning them of the great necessity for the construction of a sea-wall as a means of protection. This letter was a strong appeal, and while it provoked much newspaper discussion, no active steps were taken to carry out the plan offered. When the people of Galveston awoke from their night of death in September 1900, Judge Ballinger's plan was again brought to light, and, although the author had long since passed away, it required no new appeal to spur the then thoroughly aroused people to the point of action.

On 22 Nov. 1901, the Board of Commissioners of the city of Galveston appointed a board of engineers, consisting of Brig.-Gen. H. M. Robert, United States army (retired), Alfred Noble and H. C. Ripley, engineers of national renown, to devise a plan for the protection of Galveston against destructive overflows. On 25 Jan. 1902 this board submitted a plan calling for the construction of a solid concrete sea-wall and the raising of the city's grade. The raising of the grade was not only intended to furnish a solid backing for the sea-wall, but also to prevent the water from the Gulf, in the severest storms, from ever reaching a depth in the city dangerous to life or property. The plan for protection submitted by this engineering board was accepted as the best that could possibly be devised. The county of Galveston, through the Commissioners' Court, agreed to construct the granite concrete sea-wall, and provide a 150-foot right of way and filling for the same, with the understanding that the city proper, with aid from the State of Texas, would undertake the task of raising the grade.

Construction of the Sea-Wall.— This wall is 16 feet at the base, 16 feet high and 5 feet wide at the top, curving from the top to the base. The concrete is composed of one part of cement, three parts of sand and six parts of crushed granite. At intervals of three and one-half feet there is placed in the wall one and one-half inch square corrugated steel reinforcing rods 10 feet long. The riprap on the Gulf side of the wall is 27 feet wide and from three to seven feet in thickness, and is composed of granite.

Raising the Grade.— In order to carry out the plan for raising the grade, the legislature of the State authorized the city to issue bonds to the amount of $2,000,000 at a rate not to exceed 5 per cent. In order to aid the city in caring for these bonds the State granted it $70,000 per annum for a period of 17 years. The management, control and direction of this work were entrusted to three commissioners appointed by the governor and known as the «Grade Raising Board of the City of Galveston.»

GALWAY, Ireland, a municipal and parliamentary borough, a seaport and a county of itself at the mouth of the river Corrib, on the north shore of Galway Bay, 65 miles northwest of Limerick by road. The old town is poorly built and irregular. The new town consists of well-planned and spacious streets, and is built on a rising ground which slopes gradually toward the sea and the river. Galway is the see of a Roman Catholic bishop, but is in the Protestant Episcopal diocese of Tuam. The principal buildings are the cruciform church (Episcopal) of Saint Nicholas (1320); Saint Augustine's Roman Catholic church (1859), monasteries, nunneries, the county courthouse, barracks, prison, infirmary and Queen's College (1849). Galway has flour-mills, a distillery, iron foundries, marble yards, extensive salmon and sea fishing, one of the best and safest harbors on the Irish coast and a lighthouse. The exports consist mainly of agricultural produce, wool and black marble. It was taken by Richard de Burgh in 1232. From the 13th till the middle of the 17th century it continued to rise in commercial importance. In 1652 it was taken by Sir Charles Coote, after a blockade of several months; and in July 1691 it was compelled to surrender to General Ginkell. The borough returns one member to the House of Commons. Pop. 15,944.

GALWAY BAY, a large bay on the west coast of Ireland, between County Galway on the north and County Clare on the south, about 30 miles in length and from 20 to 7 miles in breadth. Across its entrance lie the Aran Islands, and there are numerous small islands in the bay itself.

GÁMA, gä'mä, Antonio Leon de, a Mexican scientist: b. City of Mexico, 1735; d. 12 Sept. 1802. He was secretary to the Supreme Court for a number of years, and subsequently was a professor at the School of Mines. He is best known for his study of the celebrated Aztec calendar stone which was discovered in his time. He was one of the first students of the remains of the past civilizations of America to place the development of archæology upon a scientific basis. For this reason his name stands high in Latin-American scientific circles.

GAMA, José Basilio da, Brazilian poet: b. São José (Minas Geraes), 1740; d. Lisbon, 31 July 1795. He was educated by the Jesuits and joined the company; but on the expulsion of the order in 1795 he left Rio de Janeiro where he had been in a monastery and returned to the seminary of São José. Later on he went to Portugal; and from there he paid a visit to Rome, where he seems to have become closely identified with the prominent representatives of the Catholic faith. On his return to Rio de Janeiro, he was seized as a Jesuit and sent back to Lisbon. There he saved himself by renouncing the Jesuit order and allied himself to the strongly royalist interests. This, backed up by the powerful influence of statesmen, among them Pombal, and his poetical flatteries addressed to the royal family, secured for him an important position in the Ministry of Foreign Affairs. Returning to Rio de Janeiro in 1777 he founded the *Arcadia Ultramarina* on the lines of that of Rome, and became himself a prominent literary figure in the life of the colony. Suspected of plotting treason, by the viceroy, Count Rasende, Gama returned to Lisbon where he spent the rest of his life. His epic poem, 'O Uraguay,' which accused the Jesuits of attempting to form an independent papal nation of the Indians of Uruguay, attracted to Gama considerable notoriety. He was a fairly good poet and has left numerous lesser poems of considerable merit.

GAMA, Vasco da, väs'kō dä, Portuguese navigator: b. Sines, Portugal, 1450; d. Cochin, India, 24 Dec. 1524. He was the first navigator who made the voyage to the East Indies by the Cape of Good Hope. Bartholomew Dias, a Portuguese explorer, having visited the cape, which he called Cabo Tormentoso, or stormy cape, brought back such interesting accounts of his discoveries that the Portuguese sovereign, Emanuel, following the policy of his predecessor, John II, determined to urge discovery beyond the point where Dias left it, and if possible to reach by sea the countries of the Indies. Accordingly an expedition was placed under the command of Vasco da Gama, a gentleman of the king's household and a skilful and experienced mariner. The fleet consisted of the *San Gabriel*, flagship of 120 tons, the *San Rafael* of about 100 tons, a caravel of 50 tons and a store-ship, with a total force of 160 men. On 8 July 1497 Gama's expedition departed from Lisbon for the Cape Verde Islands, whence it set sail on 3 August southward along the African coast. On 7 November they put into a bay called Saint Helena, and departed on the 16th. They then encountered a succession of tempests such as had gained for the southern promontory of Africa the name of the Cape of Storms. The courage of Gama's companions failed, and they besought him to put back, which he not only refused to do, but put the ringleaders of the movement in irons, and held on his course into the stormy sea. On Wednesday, 20 November, they doubled the Cape of Good Hope. On Christmas Day having sighted the coast, it was named Natal, in honor of the day. Further north they discovered Mozambique; the island of Açoutado; the island of Mombassa, and Melinda, where the king gave them a pilot to conduct them across the Indian Gulf. The Melindese pilot is reported to have been acquainted with the astrolabe, compass and quadrant. Under his guidance the voyagers steered 750 leagues across the open sea. In 23 days they arrived off the Malabar coast, and on 20 May 1498 they reached Calicut, the object of their search. Their mission was thus accomplished, and a new route to the East established. Gama's relations with the ruler of Calicut were not cordial; and, therefore, leaving the Indian coast on 15 October, Gama returned to Lisbon, calling at Melinda on the way to take on board an ambassador to Emanuel's court, and arriving in the Tagus September 1499, after an absence of two years and two months. He brought back one ship, a caravel which he had chartered at Cape Verde, and 55 men. The king received Gama most cordially.

Emanuel immediately fitted out a second fleet of 13 ships, with 1,200 men, under the command of Pedro Alvarez Cabral, to establish trading posts; but failing in its ends, another fleet of 20 ships was placed under command of Gama. This expedition, which was warlike in its character, sailed early in 1502. On reaching Calicut, Gama immediately bombarded the town, enacting deeds of inhumanity and savagery too horrible to detail. From Calicut he proceeded to Cochin, and, having made favorable trading terms with it and other towns on the coast, he returned to Lisbon in September 1503 with richly laden ships. He and his captains were welcomed with great rejoicing; Da Gama himself having great privileges conferred on him, and being made admiral. Soon after his return Vasco retired to his residence in Evora, and for 20 years took no part in public affairs, either from pique at not obtaining, as is supposed by some, so high rewards as he expected, or because he had in some way offended Emanuel. During this time the Portuguese conquests increased in the East, and were presided over by successive viceroys. The fifth of these was so unfortunate that Gama was recalled from his seclusion by Emanuel's successor, João III, created count of Vidigueira, and nominated viceroy of India, an honor which in April 1524 he left Lisbon to fill. Arriving at Cochin in September of the same year, he immediately set himself to correct, with vigor and firmness, the many abuses and evil practices which had crept in under the rule of his predecessors. He was not destined, however, to prosecute far the reforms he had inaugurated, for on Christmas eve following his arrival he died, and was buried in the Franciscan monastery there. In 1538 his body was conveyed to Portugal and entombed in the town of Vidigueira, of which he was count. The important discoveries of Vasco da Gama had the result of enriching Portugal, and raising her to one of the foremost places among the nations of Europe. Consult Correas, 'The Three Voyages of Vasco da Gama' (Hakluyt Society 1869); the 'Journal' of his first voyage, edited by Ravenstein (Hakluyt Society 1898); Jayne, 'Vasco da Gama and His Successors 1460–1568' (London 1910).

GAMALIEL ("God is a reward"). Two persons of this name are mentioned in Bible history. The first, Gamaliel, the son of Pedahzur, in the book of Numbers, i, 10; ii, 20; vii, 54, 59; x, 23, as prince or head of the tribe of Manasseh. The other and better known Gamaliel is mentioned twice in the Acts of the Apostles. In both passages he appears as a learned doctor of the law of the sect of the Pharisees. From the one we learn that he was the preceptor of Saint Paul, who was brought up in Jerusalem, "at the feet of Gamaliel." In the other we find him advising the council of Sanhedrim in regard to their treatment of the apostles, and it is the advice given on this occasion which has rendered him famous. "If this counsel or this work," he said, "be of men it will come to naught, but if it be of God ye cannot overthrow it, lest haply ye be found to fight even against God." Ecclesiastical tradition makes Gamaliel become a Christian, and relates that he was baptized by Saint Peter and Saint Paul; but the story does not appear to be supported by any evidence. He has been identified by scholars with Gamaliel, the son of Simeon and grandson of Hillel, president of the Sanhedrim under Tiberius, Caligula and Claudius.

GAMARRA, gä-mär'rä, Augustin, Peruvian general: b. Cuzco, 27 Aug. 1785; d. Yngavi, 20 Nov. 1841. He fought in the Spanish army in 1809–21, attaining the rank of lieutenant-colonel. He went over to the revolutionists in 1821, became general and was made grand marshal. He marched into Bolivia (1827), and effected the Treaty of Pisagua (1828). From 1829 to 1833 he was President of Peru, and on the expiration of his term of office he tried to continue to hold the presidency by military force; but was compelled to depart hurriedly into Bolivia and later was variously identified with the political disturbances of the time. In 1837 he took a leading part in Chilean opposition to the Bolivia-Peru confederation; and upon the conclusion of a successful campaign in which he commanded the Peruvian reserves, he became President of Peru (1839). He was killed in battle during an invasion of Bolivia.

GAMBA, a stringed instrument of the viol sort, called also viola da gamba, with six strings, weaker in tone and smaller in size than the violoncello, so called because it was held between the knees of the player, as distinguished from viola da braccia, played on the arm. Also an organ stop, the pipes of which are, in continental organs, generally cylindrical, of small scale, and well cut up, but sometimes conical in shape.

Its tone is pungent, and not unlike that of a violin or violoncello.

GAMBADO, or GAMBADE, a leather legging for equestrians; it is wrapped round the leg, reaching from the knee to the foot, and is fastened at the side by clasps. The term is also used for boots fixed to the saddle instead of stirrups.

GAMBESON (spelled also *gambeison*). A defensive body garment worn in the chain mail period. (See CHAIN ARMOR). Its description and name vary at different times or at the hands of different contemporary writers, being termed also *wambais, wambeys* or *wambeis* and *acketon* or *haketon*. It was wadded with wool and quilted in parallel lines. In the 13th century it took the place of the tunic under the coat-of-mail (see HAUBERK) to break the force of blows in combat. It, at times, was long enough to reach the knees and shows up (in old illustrations) for several inches below the shorter hauberk. The gambeson was worn also by foot-soldiers and knights often as the sole body defense; again, it appears to have been worn over the hauberk, sometimes with a superimposed surcoat; or the surcoat has been termed *gambeson* when gambisoned (quilted) with cotton wool. A defensive coat of this same form but made of leather appears to have been termed *gambeson*.

GAMBETTA, găm-bĕt'tä, **Léon Michel,** French statesman: b. Cahors, France, 3 April 1838; d. Sèvres, France, 31 Dec. 1882. He was of Genoese extraction; was educated for the Church; but finally decided in favor of the law; and going to Paris became a member of the metropolitan bar in 1859. In November 1868 he gained the leadership of the Republican party by his defense of Delescluze, a noted Republican. In 1869, having been elected by both Paris and Marseilles, he chose to represent the latter city; and in the Chamber of Deputies showed himself an irreconcilable opponent of the empire and its measures, especially of the policy which led to the war with Prussia. On the downfall of the empire, after the surrender of Sedan in 1870, a government for national defense was formed, in which Gambetta was nominated Minister of the Interior. The Germans having encircled Paris, he left that city in a balloon, and set up his headquarters at Tours, from which, with all the powers of a dictator, he for a short time organized a fierce but vain resistance against the invaders. In the capitulation of Paris, he resigned. After the close of the war he held office in several short-lived ministries, was president of the Chamber under Grévy, and the director of its policy; and in November 1881 accepted the premiership. The sweeping changes proposed by him and his colleagues speedily brought a majority against him, and after a six weeks' tenure of office he had to resign. The accidental discharge of a pistol led to his death, which was deeply mourned in France. He had remarkable oratorical gifts, the faculty of command and showed consummate tact in uniting the extremists of the Republican party with the centre, in opposition to all the reactionary elements in France. He founded *La republique française* in 1871. Consult Reinach, 'Léon Gambetta' (1884); Harrison, 'Leon Gambetta, a Positivist' (1892); Tournier, 'Gambetta' (1893); Gheusi, 'Gambetta: Life and Letters' (English trans. 1910).

GAMBIA, (1) a British colony in West Africa, occupying portions of territory at the mouth of the river Gambia, some of its islands, and (including the adjacent territory under British protection) about six miles of land on either bank for a distance of 250 miles from the sea, and the navigable waters of the Vintang Creek. It thus forms a narrow strip running through French territory; total area, about 4,500 square miles. The principal settlement is Bathurst, at the mouth of the river. There is comparatively little fertile land, and agriculture is primitive. Gambia differs very little from the other West African settlements in being unhealthful. The position of Bathurst, the seat of government, is very unhealthful in the rainy season. There are a number of Anglican, Roman Catholic and Wesleyan schools in the colony. Cotton cloth is manufactured to some extent by the natives, who also prepare palm-oil, build boats, etc. The principal exports are groundnuts, rubber, beeswax, ivory, hides, gold and palm-oil. The value of imports in 1912 was over \$3,700,000 and the exports amounted to \$3,600,000 and in 1915 \$1,471,941 and \$1,766,-543 respectively. Gambia is a Crown colony under an administrator, who is assisted by an executive and a legislative council. The population of the entire region in 1911 was about 138,400, including about 200 whites, the remainder being chiefly negroes. (2) A river flowing through the above colony and giving to the colony its name. Rising in the mountains of Senegal, after a course of about 700 miles it expands into a broad estuary and at Bathurst enters the Atlantic Ocean. For 170 miles it is navigable by seagoing vessels.

GAMBIER, găm'bĕr, **James,** BARON, English naval officer: b. New Providence, Bahamas, 13 Oct. 1756; d. near Uxbridge, England, 19 April 1833. He entered the navy and off Ushant fought with distinction as commander of the *Defence* under Lord Howe in 1794. In 1802 he was appointed governor of Newfoundland. As admiral he commanded the British fleet at the bombardment of Copenhagen in 1807 and was rewarded with a peerage. At the action in Basque Roads in 1809 he refused to act on the instructions of Cochrane, Lord Dundonald, was tried by friendly court-martial and acquitted. He was one of the commissioners who negotiated the Treaty of Ghent in 1814. Gambier attained the rank of admiral of the fleet in 1830.

GAMBIER, Ohio, village of Knox County, on the Cleveland, Akron and Columbus Railroad, 50 miles north of Columbus. It is noted for its educational institutions, including Kenyon Episcopal College (q.v.), Bexley Theological Seminary and the Harcourt Place School. Pop. 537.

GAMBIER ISLANDS, or ARCHIPELAGO, a group of small islands of the south Pacific about lat. 23° 8′ S. and long. 134° 55′ W. The total area of the group is about 10 square miles. The natives are a well-formed race and have made some progress in civilization. On Mangareva, the largest of the group, some French missionaries settled in 1834 and the islands now belong to France. The total population is about 500 or 550.

GAMBIR, or GAMBIER, called also *Terra japonica*, an astringent substance obtained from the *Uncaria gambir*, a tree of the family *Cinchonaceæ*, cultivated in Sumatra and other islands of the Malay Archipelago. It is obtained from the leaves by boiling or infusing them in water, inspissating the resulting fecula and forming into cakes. The Chinese use it for chewing and in the Western world, principally in Great Britain, it is employed in dyeing and tanning, also medicinally. It is mostly exported from Singapore. It is often considered as one of the articles of catechu (q.v.).

GAMBLE, Francis Clark, Canadian civil engineer: b. Toronto, Ontario, 1848. He was educated at the College of Upper Canada; in 1869 became a civil engineer on the Intercolonial Railroad, in 1872 assistant engineer of the Great Western. He was later assistant engineer of the Canadian Pacific and in 1881 was made assistant engineer of the Department of Public Works of British Columbia, was resident engineer and agent from 1887 to 1897 and from 1898 to 1911 was engineer of public works. In 1911 he became chief engineer and inspecting engineer of railways. He is a member of the Canadian Society of Civil Engineers and of the English Institute of Civil Engineers and the American Society of Civil Engineers.

GAMBLE, Hamilton Rowan, American statesman: b. Winchester, Va., 1798; d. 1864. He was admitted to the bar in Virginia, settling in Missouri 1818 and being elected secretary of state of that Commonwealth 1823. Practising law at Saint Louis he became judge of the Supreme Court and was elected a member of the Constitutional Convention 1861 and appointed by it governor in place of C. F. Jackson, who had become a secessionist.

GAMBLING, or GAMING, the practice of playing for a money stake, games depending solely on chance, like roulette, for instance, or those other games into which the element of skill enters, as in the cases of whist or billiards. Strictly speaking, gambling may be understood as gaming in its worst sense and as implying professional play for a money stake by men who are unscrupulous adepts at so-called games of chance. Gambling has been common among most nations, civilized and uncivilized. The practice of civilized communities in regard to these acts has been far from uniform. The odium of gambling has sometimes been attached to games perfectly innocent in themselves and these games have been prohibited to the manifest prejudice of the law, which has thus been brought into dishonor and contempt. At other times, governments, tempted by the facilities of sharing in the dishonest gain, have openly and shamelessly encouraged gambling by licensing gaming-houses, or instituting lotteries under their own authority. See LOTTERY.

Gambling in Europe.— In England gambling was early made the subject of penal enactments. Statutory restrictions upon games and gaming go back as far as Richard II. In France, public gaming-tables were suppressed from 1 Jan. 1838. Previous to the formation of the new German Empire gambling was encouraged by official countenance in several of the principalities of Germany. Baden-Baden, a watering-place in the grand-duchy of Baden, and Homburg, then in the landgravate of Hesse-Homburg, were until comparatively recent times the two most famous resorts in Europe of the frequenters of gaming-tables. Since the suppression of gambling in these places, after the formation of the Empire (31 Dec. 1872), the principally of Monaco in Italy has become the last public resort of this species of grambling in Europe.

Repression of Gambling in the United States.— In the United States the keeping of a gambling-house is indictable at common law as injurious to morals; and most States and Territories have passed laws against gambling, some of them severe and stringent. Yet till 1880 gambling was common and open in many parts of the United States; and it was left largely to societies for the suppression of vice, especially in New York, to stir up the authorities to put the laws in force. In 1881–84 prosecutions and convictions were very numerous; in 1885 almost all the chief cities in the Union followed the example of New York and since that time the progress of legislation on this subject has been noteworthy in many of the States. Always there is difficulty in legally defining gambling and distinguishing in judicial practice between acts which violate the gambling laws and those which, while presenting some questionable appearances, are yet not obviously to be classed in the same category. As in so many other matters of public policy, there is also a loss of power to the regulative sentiment of the people through want of uniformity or any considerable degree of identity among the laws of various States and sections. Therefore it is scarcely strange that, in spite of all prohibitive legislation and repressive influences brought to bear by public opinion, gambling should, either through connivance of the authorities or by secrecy and evasion, continue to be practised in many of the large cities of the United States. As in all other matters of public interest, the moral sentiment of the community steadily seeks and no doubt gradually finds a controlling expression through its official representatives in the legislative field and in local and general administration. Consult Coldridge and Hawksford, 'The Law of Gambling, Civil and Criminal' (London 1913).

GAMBOGE, găm-bōj' or -booj', a gum-resin derived from *Garcinia cambogia*, a member of the order *Guttiferæ*. The gamboge tree itself is a native of Siam, Cochin-China, Cambodia (which gives the drug its name), from which places the drug is imported to Europe and to the United States. Other forms of gamboge that are rarely seen in the American market are found in India, China and the Asiatic Islands. The gum-resin is obtained by cutting or wounding the trunks of the trees causing a bright yellow juice to flow. This is collected, usually in bamboo joints, and hardens naturally, or is dried over a fire, until a solid mass results, which generally takes the shape of the collecting vessel. In the drug market pipe gamboge, press gamboge and cake gamboge are recognized. Pipe gamboge is preferred because it is usually clean. As a pigment for painting, gamboge has been known for centuries and as a purgative it has been used in

China as long as history gives any definite information.

The gum-resin contains a large amount of gum, 15 to 20 per cent and 70 to 80 per cent of a yellow resin, gambogic acid, on which its purgative properties depend. The formula of gambogic acid is $C_{40}H_{28}O$. Taken into the body in doses of from two to five grains, it acts as a very active hydragogue cathartic, producing numerous watery stools, with much griping. It is principally valuable when combined with some other drug that tends to diminish the pain and it is one of the most important ingredients in the compound cathartic pill of the United States Pharmacopœia, which contains one-quarter of a grain of the resin. Overdoses cause violent poisoning with intense prostration.

GAMBRINUS, găm-brī'nŭs, a mythical king of Flanders, inventor of beer, said, probably incorrectly, to have an original in Jan Primus (or Jan. I), Duke of Brabant. He is represented in Germany as Saint Gambrinus, patron of drinking. His figure is familiar in German beer-cellars, often seated astride a cask, a foaming tankard in his hand.

GAME BREEDING signifies to most persons the rearing in captivity of gallinaceous birds for purposes of sport, as pheasants, grouse, quails and the like; but it must be extended to include the rearing of wild ducks and geese in confinement to be sold as food. The peacock, turkey and our domestic poultry (originally jungle fowls) are familiar examples of ancient success in this direction and local species of wild birds of this order are «pets» in all parts of the world. Great Britain rears annually, under personal care, millions of the common South-Russian pheasant (see PHEASANT) for the sake of sport in the autumn; and great quantities of this game and of the red grouse preserved on the grouse-moors of Scotland and elsewhere have been utilized as food in the scarcity of food resulting from the present war in Europe. The ring-necked pheasant of eastern China and Japan was long ago taken to Europe and has interbred with the Western pheasants until now it is difficult to find any of either kind there of pure blood. This ring-neck was introduced from semi-domesticated Japanese stock into Oregon about 1890 and in a few years had become a common wild bird throughout all that coast-region and still remains so, although no particular care has been given to it. This is owing to the similarity of the mild climate to that of their native lands. Some years later pairs of these and of the British pheasants were acclimated in the Eastern States and did well. They are now reared on country estates and farms all over the United States for both pleasure and profit and in many places have been turned out as wild birds. They are described as light eaters, of good size and are very prolific; and both birds and eggs bring excellent prices. Several other species are reared, with more trouble, for ornamental purposes, principally the golden, silver, eared, Reeve's and Lady Amherst's pheasants; but they are more costly and less hardy. Very full and trustworthy directions for their care during the breeding season, the treatment of the young, feeding, etc., may be found in the books quoted below.

The wild turkey has been bred in some cases, but only where an extensive tract of enclosed wild woodland is available. It is possible to rear any of the grouse, but only the ruffed grouse has been successfully produced and this is attended with many difficulties on account of the pugnacity of the male and other troublesome factors. Each pair requires a large, separate wire-enclosure, the cost of which is so great that grouse-culture will not be profitable commercially until the wild supply is much diminished. The cultivation of bob-white (our American «quail,» called «partridge» in the South, where the ruffed grouse is known as «pheasant») has been undertaken on a large scale and with considerable success on Long Island and in some other favorable places; but each breeding-pair must have a small separate enclosure and the eggs must be incubated in almost every case by a bantam hen. The increase is fast, but when the birds are strong the coveys are likely to stray out of bounds. The Mexican scaled quail, a very pretty and interesting bird, has been reared on several Northern estates as also has the California and other Western quails; but these are pets and ornaments only, as yet. The methods of culture have been learned, however, and hereafter may be of much service in restocking depleted areas. The common European partridge was imported very largely a few years ago under the name Hungarian partridge and was bred easily in preserved tracts; but it disappointed the hope of sportsmen, has not multiplied and is no longer in favor. On the whole the breeding of game-birds, while a very delightful amusement, has not become of any practical importance.

The breeding of waterfowl has much the same history. The Canada and other wild geese have long been reared by themselves in confinement, or are mixed with tame flocks; so, also, has the mallard, from which, indeed, our domestic ducks are mainly derived. Black ducks are easily domesticated and these, with mallards, are produced for market in some places. Experiments show that with labor and much expense any of the fresh-water ducks may be reared; but thus far the matter is one of enjoyment rather than profit. Many extensive «game-farms,» devoted to cultivating and selling breeding-stock of these various birds, exist in the Northern States; but the movement for general game-production in this way encounters considerable popular opposition and does not receive the legal encouragement that it desires and perhaps needs, owing to popular prejudice against its apparent exclusiveness. Consult files of the *Game Breeder* magazine and the writings of its editor, Dwight Huntington; Bulletins No. 1 and No. 2 of the National Association of Audubon Societies; Job, H. K., 'The Propagation of Wild Birds' (New York 1915).

ERNEST INGERSOLL.

GAME-FOWLS. See COCKFIGHTING; POULTRY.

GAME LAWS, legislative enactments adopted by nations and states to prohibit or regulate the killing of wild animals, birds and fishes. In Great Britain the game laws are a relic of the forest laws, which in the time of the Norman kings were so oppressive; it being under the Conqueror as great a crime to kill one of the king's deer as to kill one of his subjects. A certain rank and standing, or the possession of a certain amount of property, were for a long time qualifications indispensably necessary to confer upon any one the right of pursuing and killing game. By the Game Act of William IV the game laws were greatly modified, the necessity for any qualification except the possession of a game certificate being then abolished and the right being given to any one to kill game on his own land, or on that of another with his permission. Every uncertificated person selling game is also required to take a yearly license. The animals designated as game by this act are hares, pheasants, partridges, grouse, heath-game or moor-game, black-game and bustards. These animals (with the exception of hares) are not allowed to be killed at all times, there being a certain season of the year — the close season — during which all people are prohibited from killing game. By an act of 1880 every occupier of land has a right, as inseparable from and incident to the occupation of the land, to kill and take ground game (hares and rabbits) thereon, concurrently with any other duly authorized person, all agreements in contravention of this right being declared void. Game laws of greater or less strictness are in force in many other countries. In Canada the chief restrictions are in regard to killing wild animals during the breeding season.

Game Laws in the United States.— In the United States wild game whether of forest, field or stream is perhaps better protected than in any other country in the world. Although there are certain general national laws, all States have passed game laws of their own and many States have organized societies for the protection and preservation of game. There are eight national organizations, the most important being the League of American Sportsmen. The others are the American Ornithological Union; the National Sportsmen's Association; the National Bird, Game and Fish Protective Association; Bird Protective Society of America; Boone and Crockett Club; International Forest, Fish and Game Association and North American Fish and Game Protective Society. Nearly every State in the Union has now a Game and Fish Commission and numerous game wardens.

The national game law, known as the Lacey Law, passed by Congress in 1900, gave to the Department of Agriculture certain powers, by which among other provisions no importation of wild animals, birds or fishes could be made without a permit from Secretary of Agriculture.

Many important additions and amendments to the Federal laws have been passed during the last 10 years, all tending to protect game and game birds in their natural state without interfering with the importation of birds, birds' eggs or animals for breeding purposes. During 1910 there was an increase in these importations. Foreign mammals were imported to the number of 7,862, less than 600 of which could be classified as game animals, while the number of game birds imported was 49,989. Among the importation of the year were the valuable specimens obtained for the National Zoological Park at Washington through the Roosevelt expedition and containing, among other mammals, several African antelopes and a lophiomys, a peculiar maned rodent rarely seen in zoological collections. Another shipment worthy of special mention was the six musk oxen brought from the Arctic regions for the New York Zoological Park by Paul J. Rainey, this being the largest number ever brought to the United States.

European Game Birds for American Covers.—A great deal of interest has been manifested in the experimental stocking of American covers with European game birds. The Hungarian partridge was the favorite prior to 1910, but since that time there has been a marked tendency to return to the pheasant. Thousands of pairs of partridges and English ringneck pheasants have been imported and distributed in Indiana, New Jersey, California, Colorado, Louisiana, Oklahoma, Iowa, Vermont, the Dakotas and other States. Pheasant eggs have been imported for hatching and later liberation. The experiments with other game birds has been so disappointing that practically nothing was done along these lines.

The movement toward securing uniform laws for the protection of song, insectivorous and other non-game birds has also made substantial progress since 1900. The Shea plumage bill, prohibiting the sale of aigrettes and other plumage, took effect 1 July 1911. Laws protecting non-game birds have been very generally adopted in Canada.

Protectors, Seizures, Sportsmen's Associations, Close and Open Seasons.— New York since 1902 raised the number of salaried protectors from 50 to 90 and New Jersey has given its wardens every power to make searches and seizures. The total number of authorized game protectors in the 42 States reporting in 1910 was 9,354. Of these 748 were salaried officials, 1,167 were paid per diem and 7,439 performed their services without remuneration.

Under the Lacey Act numerous seizures were made of game shipped from the West and Southwest and proceedings were instituted in a number of cases in State and Federal courts. In some of the cases in Iowa and South Dakota convictions were secured with penalties ranging from $150 to $200. The inspection of foreign birds at the port of New York was made more effective and special inspection service was established in Hawaii and extended in scope so as to prevent the introduction of noxious reptiles into the islands.

Even more important than the enactment of new game laws has been the work of game commissions and voluntary organizations interested in the practical protection of birds and game. In 1910 important changes were made in the game commissions of several States and five salaried game wardens were appointed in Alaska. Several sportsmen's game and fish protective associations were added to the large number already existing and the Audubon Society began a special campaign of bird protection in the South. Nearly all the States now have Audubon societies, which are formed primarily for the protection of birds other than game. The committee of the American Ornithologists' Union on the protection of birds extended its work along the coast and now maintains supervision of all the breeding colonies of sea birds on the Atlantic coast from Eastport, Me., to Chesapeake Bay, as well as at some points in Florida.

Practically all the State game laws passed by the various State legislatures prohibit the export of game, hunting or fishing for commercial purposes and hunting big game with dogs. In a few States the netting of minnows for bait is also prohibited. The killing of song birds is forbidden in most of the States, but this law does not apply to the hawk, owl, crow, blackbird and English sparrow. Hunting and fishing in the national Yellowstone Park is prohibited.

While the close and open season for hunting and fishing are well defined in all the States, there is no general statement that can cover the question, the seasons and conditions varying so widely. In Alabama, for instance, deer may be shot for two months only (November to January), in Indiana at no time, and in Illinois no deer can be shot until 15 June 1919. All State game laws are peculiarly adapted to local conditions.

New regulations on close seasons for migratory birds were made public 22 Aug. 1916 by the United States Department of Agriculture, after its approval of recommendations by the Federal Advisory Committee on the Migratory Bird Law. Spring shooting has been everywhere refused. It has been adopted as a fixed rule for the present that in no part of the country may there be shooting after the game has started for its breeding grounds in the North. The committee recommended a maximum shooting season of three and one-half months for any section of the country and tried to equalize opportunity as best it could in fixing that season. Among the valuable North American birds that the committee said were "candidates for extinction" were the whooping crane, trumpeter swan, American flamingo, roseate spoonbill, scarlet ibis, long-billed curlew, upland plover, Hudsonian godwit, red-breasted sandpiper, golden plover, dowitcher, willet, pectoral sandpiper, black-capped petrel, American egret, snowy egret, wood duck, band-tailed pigeon, heath hen, sage grouse, white-tailed kite, prairie sharptail, pinnated grouse and woodcock. See AUDUBON SOCIETY; FISHING; HUNTING.

GAME PRESERVES, or GAME PARKS, are large reservations of land, usually including mountain and forest, set aside by the government or individuals, for the propagation and preservation of game. Game preserves have been well known in Great Britain and on the Continent for upward of five centuries. Henry VIII established a royal deer park near Hampton Palace in 1526, and the Duke of Sutherland at the present day owns the largest game preserve in the world. Game preservation in the United States first attracted attention just prior to the Civil War and later when the rapidly increasing settlement of the States threatened the extinction of all kinds of wild game.

The United States government took up the question of game preservation almost as soon as the individual, and the establishment of the Yellowstone National Park in the Rocky Mountains and the Yosemite National Park in California had as much to do with the protection of big game as in the preservation of forests. In these two reservations the government ranges have endeavored to preserve and protect such large game as the buffalo, elk and moose. The other nine national parks nearly all include reservations for the protection and preservation of wild animals, including birds. In 1902, President Roosevelt, himself a hunter of big game, declared no less than 12 new national forest reserves which, while largely important to forestry, will greatly assist in the protection of big game. These new reserves had a total area of 14,276,476 acres. Since that time many important additions have been made to the list of reservations, some of which follow:

	Acres
San Isabel, Colorado	77,980
Santa Rita, Arizona	337,300
Niobrara, Nebraska	123,779
Dismal River, Nebraska	85,123
Santa Catalina Arizona	155,520
Mount Graham, Arizona	118,600
Lincoln, New Mexico	500,000
Chiricahua, Arizona	169,600
Madison, Montana	736,000
Little Belt Mountains, Montana	501,000
Alexander Archipelago, Alaska	4,506,240
Absaroka, Montana	1,311,600
Grand Canyon, Arizona	1,402,930
Afognak Forest, Alaska	512,000
Mount Olympus, Washington	608,640
Montana National Bison Range	18,521
Munkunyuweap, Utah	15,840
Colorado National Monument, Colorado	13,883
Billy Meadows Pasture, Oregon	2,560
Mobrara Reservation, Nebraska	1,250

There are also numerous State preserves. Wyoming has five, including Teton State Preserve of 576,000 acres; Pennsylvania five, of a total of 1,600 acres; Montana has the Snow Creek Game Preserve of 57,600 acres; and New York State has the famous Adirondack State Park.

Of private game parks in the United States, the first of record was that of Judge J. D. Caton of Ottawa, Ill., the author of 'Deer and Antelope in the United States.' This he established in 1860, for sport and study, bringing together on his large estate many varieties of game animals native to America. In 1889, Austin Corbin enclosed the area known as Blue Mountain Forest, situated near Newport, N. H. It contains over 36,000 acres and is surrounded by a wire fence, eight feet high, forming an oblong tract 12 by 5 miles, and which is crossed by a mountain range, the peaks of which are 3,000 feet high. Here are miles of wooded slopes, dense forests and broad meadows, giving food and shelter to all kinds of game animals, from the buffalo, elk and moose to the smaller species. The experiment has been most successful, nearly all of the animals thriving and increasing rapidly in numbers. In 1870, F. S. Giles laid out the Grove Park reservation, containing 17,000 acres and this experiment was followed by Dr. W. Seward Webb with a preserve of 9,000 acres at Nebasane, N. Y., in the Adirondacks, Northern New York, and another preserve at Shelburne, Vt. The Litchfield Park at Tupper Lake, N. Y., in the Adirondacks, was established in 1893, with 9,000 acres, and in 1900 hundreds of herds of large game were roaming the mountain forests within this tract. In the same region the Adirondack Timber Company has a park of over 30,000 acres, well stocked with animals. George W. Vanderbilt at his Carolina estate of Biltmore has 80,000 acres, 6,000 acres of which are enclosed and well stocked with game. A small army of men are engaged here as keepers. In many of the smaller parks particular attention has been paid to game birds, such as the English pheasant, prairie chicken and wild turkey. A lover of birds imported large numbers of Japanese pheasants for his preserve in Oregon in 1893, the experiment proving a great success. E. C. Benedict of Greenwich, Conn., has established extensive fish preserves in Long Island Sound, which are the largest and most successful of their kind in this country. Near Plattsburg, N. Y., Paul Smith owns an immense preserve around Saint Regis Lake of 40,000 acres. Large numbers of elk were brought here from the West in 1903. William C. Whitney of New York has been active in stocking the Adirondack region with big game, and in conjunction with Dr. F. E. Kendall of Saranac Lake, has restocked the forests with elk and deer. At Delaware Water Gap, Pa., on the New Jersey side of the Delaware River, Barclay Warburton of Philadelphia established in 1902 an extensive deer park, which is one of the most successful in that section of the country. Dr. R. V. Pierce bought about 20 square miles for a preserve at Saint Vincent Island, which was established in 1909 for the preservation of waterfowl. Marsh Island, La., was purchased by Mrs. Russell Sage in 1912, and set aside as a refuge for waterfowl. George Vanderbilt's Biltmore estate in North Carolina has been largely donated to the United States government as a game preserve.

In Canada there are several large game preserves, prominent among which is the Caughnawaga reservation on the Maquacippi River. The Roberval Club, which has a membership of 300 including both American and Canadian, owns a big game preserve containing 500 square miles, located in the Laurentian Mountains. Henri Menier occupies as a game park the whole of Anticosti Island, in the Gulf of Saint Lawrence.

GAME PROTECTOR LEGISLATION AND GAME LAWS, legislative enactments adopted by nations and states to govern the appointments of game officials, and formulating the rules and regulations to be observed in fishing and the hunting of game. See GAME LAWS.

GAMES, Gutierre Diez de, a Spanish chronicler and soldier of the first half of the 15th century, attached to the person of Pero Niño, Count de Buelna (1379–1453). His work which constitutes an interesting and faithful account of the life of Pero Niño from his early boyhood days is one of the most curious in any language. It is simple in form and language and direct in manner and aim. It is, therefore, of considerable value for the historical point of view. Of the life of Games himself nothing is known except what he himself personally and incidentally reveals in the course of the 'Chronicle.' He seems to have followed his master in all his wars and to have struck many a stout blow for him and his cause. So vivid and faithful are his pictures of his young master that they show how the young sons of noble families lived and acted in that age; what their interests were and how they proceeded to satisfy them. Games boasts that he was Pero Niño's standard-bearer on many an occasion when the battle raged fiercely. But he was never more truly his standard-bearer in the ardor of combat than in the intimacy of his personal description of his patron in his delightful and chatty 'Chronicle' ('Crónica de Don Pero Niño'). This work, which lay long in manuscript, appears to have been used by subsequent chroniclers and historians and to have been cited frequently from early times, as one of the most important documents relating to the history of the reign of Henry III. It was finally edited and considerably abridged by Eugenio de Llaguno Amirola, appearing in print in Madrid in 1782. Under the title 'Cancionero de Baena' a second edition was published by P. J. Pidal (Madrid 1851), and a third by Fr. Michel (Leipzig 1860). Consult Cueto, L. A. de (Marquis de Valmar), *Revue des Deux Mondes* (15 May 1853); Menéndez y Pelayo, M., 'Antología de poetas liricos, etc.'; Ticknor, 'History of Spanish Literature' (New York 1854).

GAMES. Games are an expression of the play instinct, a distinct species or form of play. A study of them includes a definition of games as distinguished from play; and a consideration of games from historical, educational and recreative viewpoints. While the term play includes games, so that we "play games," it is technically applied to informal play activities, such as playing horse, playing house and playing in the sand. In such play there are no fixed rules, no formal mode of procedure and generally no climax to be achieved. The various steps are spontaneous, not predetermined, and are subject to individual caprice. In games, on the contrary, as in blindman's buff, prisoner's base or football, there are prescribed acts, subject to rules, generally penalties for the infringement of rules and the action proceeds in a formal evolution until it culminates in a given climax; which generally consists of a victory of skill, speed or strength. This definition applies to games that require considerable bodily activity, such as those mentioned, and to so-called quiet games, as dominoes, cards, jackstraws, chess, checkers and other board games. Our concern in this article is chiefly with active games.

Among the simplest of active games are singing games, in which the action is mainly a repetition of dance movements, or of some dramatic or descriptive motions, as when the farmer sows his seed or London bridge falls down upon its victim. More strenuous are the games of chase, such as tag, cat and rat, and Red Rover; or competitive games of skill, strength or speed, illustrated by relay races and athletic contests. Highest of all, both in their organization and their demands upon the varied powers of players, are team games, of which baseball and football are popular examples. Team games are peculiar to the Anglo-Saxon race; nearly all games of the other classes are of very ancient origin and of wide distribution among the races and nations of men. Indeed, the games of children form a distinct branch of anthropology, ethnology and folklore and throw much light on early customs from which they are descended; for they come trooping out of the past unconsciously bearing the relics of primitive civilizations, of old religious rites and grim superstitions, of marriage and May-time festivals and "battles long ago.» «Oats, peas, beans and barley grows» had its origin in a religious rite intended to increase the fertility of the fields; «London bridge,» in the offering of a human sacrifice at the building of a bridge; «Here we go round the mulberry bush» is the survival of a custom, still practised by some of the European peasantry and known to have existed at least as far back as the early Greeks, of celebrating May day or spring time with the gathering of flowers and marching in procession. This usage prevailed among the American colonists and from it have come our May basket and May pole customs. Indeed, most of these singing games and many other active parlor games now played by children, such as stage coach and going to Jerusalem, were used instead of the dance by the young people of the Puritan era. Among the games of religious or superstitious origin tag should be mentioned, which, in its earliest form of iron tag, represented flight from an evil spirit, against whose influence iron was a protection. The little kindergarten game, «I put my right hand in,» is very ancient and with its chorus «Looby loo» gives evidence of having been part of a religious rite to some deity. In time it became a stately court dance, which rank it held a century ago. From the superstitious customs of divination by lot have come the doggerel «counting out» rhymes used by children the world over for choosing the principal players in games. Familiar are the stanzas of this kind beginning «Ena, mena, mina, mo» and «Onery, twoery, tickery, tee.» Of similar derivation is the custom of assigning parts by «holders,» in which one child holds a pebble in the closed hand and another guesses which hand contains it. Courtship and marriage customs are perpetuated in «Round and round the village» and «Little Sallie Waters.» Still other games, for example, «Uncle John is very sick,» come from the ballad days when a versified narrative was sung and acted at the same time;— days when to «sing a dance» and «dance a song» were interchangeable terms.

Athletic games, or competitive trials of individual strength, speed or skill under fixed rules, are probably prehistoric. The mention of them takes one's thought at once to «the glory that was Greece and the grandeur that was Rome.» The Greek games have been immortalized in literature and art; prominent examples of which are the Iliad and Odyssey, Pindar's 'Odes of Victory' and, in sculpture, the discobolus or discus thrower and the wrestlers. These Greek games were played at four stated festivals, the greatest being the Olympic, which became a national festival about 776 B.C., and recurred every four years at Olympia in Elis. The importance of the Olympic festival in Greek national life may be judged from the fact that time came to be reckoned in Olympiads. The Pythian games were celebrated in the third year of each Olympiad, the Nemean games in the second and fourth years of each Olympiad, and the Isthmian games in the first and third years of each Olympiad. All were held in honor of some god. In Homeric times the events in athletic games were chariot racing, boxing, wrestling, foot racing and javelin throwing. The Olympic contests, which came later, were probably confined at first to foot racing; to this other events were gradually added until the pentathlon came into existence, about the 18th Olympiad, and boxing and chariot racing were added in the 23d Olympiad. The pentathlon consisted of leaping, spear throwing, discus pitching, running and wrestling. It thus called for «all-over» work, thereby preventing inharmonious development by over-specialization. A competing athlete was obliged to enter for all five contests and was considered a victor only upon winning at least three of the five events. The best modern athletic games embody these principles in what are called group contests. For instance, in the pentathlon of the Young Men's Christian Association, the 100-yard dash is equivalent to the Greek foot race; throwing the 12-pound hammer is equivalent to discus throwing, the running high jump to leaping; pole vaulting for height is a substitute for hurling the spear and the one-mile run for wrestling. The prizes for the Greek games had no intrinsic value and were merely symbols of honor, as wreaths or palm branches. The prestige and indirect advantages accruing to a victor, however, became in time so great that contestants spent all of their time training for the games. The entrance of this professional and commercial spirit led to the decadence of the games. A similar degeneration occurred much more quickly in Rome. In these latter days we have had the dramatic spectacle of the revival of the Greek games as international contests, the first of these occurring in Athens in 1896. The countries represented by the contestants in these international games included Germany, England, Austria, France, Italy, Switzerland, Sweden, Hungary, Denmark, Greece, Australia and the United States. See Olympic Games.

No mention of the Greek games would be adequate that did not include the balanced relation which they held to the intellectual, artistic and ethical interests of the time. The contestants were examples of balanced culture, and the festivals drew together the greatest poets, philosophers, orators and artists whose achievements were there displayed. The tournaments or jousting bouts of the age of chivalry may be cited as a further example of athletic contests of great popularity in which the concern for physical prowess was blended with higher interests. It is notable that the modern organizations which have made physical training most popular, the German Turnverein, the Young Men's Christian Association and the colleges, also combine these varied elements.

Ranking higher as games than individual contests, because more complicated in their organization and demands, are team games in which opposing groups contest, each as a unit against the other. Each player on such a team has his assigned part or duties, differing from many of the others, but as an individual he is subordinate to the interests of his team. Games of this class are an expression of the fighting instinct and undoubtedly are a development from the simpler fighting games played by young boys, such as stealing sticks (Scots and English), and prisoner's base, which in turn are supposed to have originated in border warfare. Between these simpler games and the highly developed team games there exists the same differences of organization as between primitive and modern warfare. The former was merely a series of individual combats, the parts enacted by the various contestants being homogeneous, and, the fight, once on, very largely a matter of individual initiative. In modern warfare there is greater differentation of duties. and the individual is subordinated to the organized whole. The team games most popular in the United States are baseball, football, basket ball, cricket and hockey. Baseball has been called the national game of the United States, as cricket and Rugby football are distinctive of England, golf of Scotland and hand ball of Ireland. Basket ball bears the unique distinction of being the only game of wide and enduring popularity which was deliberately invented. Dr. James Naismith devised the game about 1892, as a result of studying the principles involved in successful games. Though invented for and played by men, it is the only team game that has become popular with women. Competitive adult games largely in vogue, which depend upon skill, rather than upon a combination of skill and organization, are tennis, golf and croquet.

The anthropological tenet, that in his development the child passes through the stages which the race has gone through before him, finds strong confirmation in children's plays and games. "The work of adults in one age of human history becomes the play of children in another." While the play of civilized children, as of savage, shows imitations of current adult activities, nearly all of the games of civilized children would seem to take their players through the primitive culture epochs. Just what this, or the lack of it, may mean for individual development we cannot say; but it may be inferred from the direct training of power which games provide.

Intellectual pastime are quite as educative as the more active physical games. In the process of the evolutional development of the average child there comes a time when mental play is a real necessity, and in later life games that employ the mind are usually preferred to those that call for physical exertion. Grandmother is often as fond of her backgammon as the college youth of his chess or the clerk of his proficiency at checkers. Backgammon, like most board games, is partly a game of chance, but there is considerable opportunity for the exercise of skill and experience. These same conditions make most of the fascination involved in games of cards. Chance determines what cards each player shall hold but he usually has choice as to what he shall play, and this affords opportunity for skill, judgment and application of the law of averages. Some games of cards, like whist, call for really scientific play to excel; others, like draw-poker, call for quick judgment of human nature, courage and bluff. Card games in which there is bidding, like auction bridge, develop the trading qualities useful to the merchant.

The gambling game, which involves the staking of money, affords another sort of mental excitement of the sort that mature minds consider harmful, but which seems to have a part in the mental development of the average individual. Intellectual games of pure ability, experience and science are typified by checkers and chess. Checkers being easy to learn is widely played by those who enjoy this mimic warfare of the calculating powers of mind against mind. Chess is far more complicated, and serves to amuse many of the highest intelligences. It is a common pastime with educated men of a mathematical turn. Every good chess player can discuss enthusiastically the training of the mind involved in playing this game of games.

The training of the hand and eye, as well as judgment and skill, are evidenced in pool and billiards, which have their devotees of all ages and both sexes, though mainly played by men, apparently because the equipment is not often conveniently within the reach of the woman or child. Pool compares with checkers, as the easy game to learn, played by the crowd, while the expert prefers billiards, and has much the same condescending air toward pool that the expert chessplayer exhibits toward the simpler game of checkers.

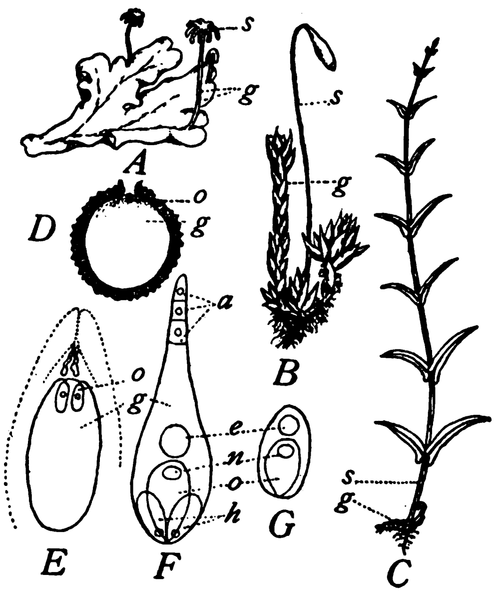
It thus appears that games, like the activities of life, show an evolutionary progress. First the rattle, then the doll, then the kindergarten play, then athletic sport and team play, then the test of hand and eye as in billiards, then the evolution through games of chance to games of intelligent skill — all pastimes imitating the more real and serious affairs of life. There is a game for every age and every taste; there is development of body and of mind; there is distinguishable an element of social progress, in recognition of the rights of others and of superior ability. The power of co-operation is recognized; resourcefulness is developed; the need of caution and value of courage are made apparent, and often the error of selfishness is thoroughly taught. The games common to an earlier age call for individual play, or the competitive element, or the homogeneous social characteristics of the folk-games. The training of the will is another strong educational feature of games. The timid, hesitating child, who at first shrinks from exposed positions or an aggressive part, gains courage and self-reliance; defeat becomes, instead of a discouragement to all effort, a spur to greater; and the inhibitive control required to obey rules and regulations, especially under strong excitement, touches another of the well springs of character. So, from the first, clumsy, timid efforts of the little child, to the skilful team work of the college athlete, at once aggressive and self-controlled, games afford a means of development and training for body, mind and character. Were any of these results objects of conscious endeavor on the part of the players, the recreative element of games would be lost. But their unique power lies in the fact of this recreation — this objective interest which holds the attention involuntarily and renders the training incidental, unconscious and natural. Because of this psychological distinction, the expression "gymnastic games," which is frequently heard, is a contradiction in terms and a misnomer. A mistake also is an occasional tendency to discard gymnastic exercise in favor of games, and vice-versa. While each is an important part of physical training, psychologically and physically there are essential differences between the two forms of exercise. Gymnastics are taken for the purpose of bodily development, and the mind is continually in the unnatural attitude of consciously directing the automatic processes of muscular co-ordination; games are played for the frolic or the victory, without subjective or utilitarian end. This psychological difference is exactly that between work and play. Physically, gymnastic exercise may be more closely adapted to individual powers and needs than the exercise of games; it can afford more vigorous exercise in a brief time to large numbers in limited space; and it is corrective of posture — of faulty neuro-muscular habits. Games, on the other hand, offer a more natural form of exercise, have a larger emotional content and in their social and psychological training are not approached by gymnastics.

The recreative element in games, the sheer fun and frolic spirit, and the engrossing interest that springs from primitive instincts, cannot be too highly valued as a relief from the pressure which modern civilization brings to bear upon both children and adults. Especially under city conditions should this be fostered. The paucity of childish play and normal youthful sport in cities, owing to lack of space, is not only pitiable, but tragic in view of all that it may mean for the healthful, balanced development and life of the individual. The growth of indoor games as basket ball and indoor baseball is admirable because making a virtue of necessity; but the movement to provide playgrounds is still better, for gangs of youthful criminals and depredators are found to melt away before them, and the play and games which they foster belong by inherent right to the open sky and the free air. See Baseball; Basket Ball; Cards; Checkers; Chess; Cricket; Football; Folklore; Golf; Hockey, etc.

Bibliography.— Berenson, etc., 'Basket Ball for Women' (1893), Bigelow, etc., 'One Hundred and Fifty Gymnastic Games' (1902); Bolton, 'The Counting-Out Rhymes of Children' (1888); Chamberlain, 'The Child: A Study in the Evolution of Man' (1900); Champlin, 'Young Folks Cyclopedia of Games and Sports' (1899); Fielde, 'A Corner of Cathay' (for games of Chinese children) (1894); Gomme, 'Traditional Games,' 'Dictionary of British Folk Lore' (1894); 'The International Games of England, Scotland and Ireland, with Tunes, Singing Rhymes and Methods of Playing' (1894–98); Gross, 'The Play of Animals' (1898); 'The Play of Man' (1901); Newell, 'Games and Songs of American Children' (1884); Plummer, 'Athletics and Games of the Ancient Greeks,' 'American Physical Education Review' (1898); Tsanoff, 'Educational Value of the Children's Playgrounds' (1897).

GAMETOPHYTE, gă-mē'tō-fīt, **Reduction of.** The gametophyte, as the name implies, is the gamete-bearing plant. In all plants which have reached the level of sexuality there is a gamete-bearing plant in the life history, alternating with another phase which may or may not bear spores. This other phase, in some algæ and fungi ,and in all plants above these two groups, does bear spores and, consequently is called the sporophyte. The gametophyte produces gametes, usually called sperms and eggs; a sperm unites with an egg, and this fertilized egg is the first cell of the sporophyte. The sporophyte, at maturity, produces spores; a spore produces the gamete-bearing plant and so the gametophyte and sporophyte generations alternate. See Alternation of Generations.

In the liverworts, the gametophyte generation is the conspicuous one, and the only one likely to be seen, except by the botanist, the sporophyte being comparatively small and parasitic upon the gametophyte (Fig. 1, *A*).



GAMETOPHYTE.

FIG. 1.— A series illustrating the reduction of the gametophyte. *A*, Marchantia, a liverwort; g, gametophyte; s, sporophyte, represented as a small black dot (one-half natural size). *B*, a moss: g, gametophyte; *s*, sporophyte; natural size. *C*, a young fern: g, gametophyte nearly rotted away; s, sporophyte; natural size. *D*, megaspore of Selaginella containing female gametophyte; the black dot, *o*, represents the egg; greatly magnified. *E*, female gametophyte of Pine; the dotted lines indicate the surrounding tissue of the ovule: g, gametophyte; *o*, egg; greatly magnified. *F*, female gametophyte (embryo sac) of Sunflower, consisting of three antipodal cells, *a;* endosperm nucleus, *e;* egg, *o;* two synergids, *h;* nucleus of egg, *n;* greatly magnified. *G*, female gametophyte (embryo sac) of Plumbaginella, greatly magnified.

In mosses, the matted cushions, which everyone calls moss, are masses of gametophyte plants. The sporophytes are the capsules, often nodding on slender stalks, which are seen attached to the gametophytes, upon which they are parasitic (*B*). In the common ferns, the gametophyte — called the prothallium — is a small thin, prostrate plant, seldom as large as one's finger nail. It produces eggs and sperms, a sperm fertilizes an egg, which then grows into the familiar fern plant. As the fern plant — the sporophyte — develops roots and becomes independent, the gametophyte dies (*C*). While this gametophyte is small and evanescent, it is green and independent as long as it lives. In some of the fern allies — Selaginella, Isoetes and the water ferns — the sporophyte produces two kinds of spore cases containing two kinds of spores, small spores, called microspores, and large spores, called megaspores. The microspores develop microscopically small prothallia (male gametophytes) which produce a few sperms; the large spores develop female gametophytes which produces one or more eggs. Both male and female gametophytes are contained within the spore, so that they are exposed only through cracks in the spore coats (*D.*) They are not green and consequently, are practically parasitic. The male gametophyte dies as soon as it has discharged its sperms; the female gametophyte, with a larger supply of stored food material, not only matures its eggs, but nourishes the young embryo until it develops roots and leaves and thus becomes independent. The gametophyte then dies. In the seed plants, which include the gymnosperms and angiosperms, there are also two kinds of spores, microspores and megaspores, which develop parasitic gametophytes. The male gametophyte consists of the microspore and a long tube, the pollen tube, which contains two sperms. The female gametophyte is not only entirely included within the megaspore but the megaspore itself is entirely included within the sporangium (ovule) (*E*). This inclusion has resulted in a more and more pronounced dependence, accompanied by reduction. In the gymnosperms, e.g., in the pine, the female gametophyte still bears considerable resemblance to that of some fern allies, but in the angiosperms, e.g., in the sunflower, the reduction has gone so far that a megaspore and female gametophyte are identified only by the evidence of comparative morphology. In this case, which represents the majority of the flowering plants, the female gametophyte consists of only seven nuclei, or loosely organized cells, so specialized that they have received individual names. The egg with two accompanying cells occupies one end of the gametophyte while three antipodal cells occupy the other extremity. Between these two groups is the endosperm nucleus, formed by the fusion of two polar nuclei (*F*). The final stage of reduction is found in an unfamiliar plant, Plumbaginella, in which four megaspore nuclei form a female gametophyte of only four nuclei, one of which organizes the egg, two unite to form the endosperm nucleus, while the fourth disorganizes; thus, at the time of fertilization, the female gametophyte has only two nuclei, the egg to start the embryo and the endosperm nucleus to start the endosperm, or nutritive tissue which support the embryo until it develops root and leaves (*G.*)

Summarizing for the female gametophyte, it will be seen that in the lower plants, the gametophyte is green and independent and is the phase which we recognize as the plant, the sporophyte being parasitic upon it. In the flowering plants, the sporophyte is the conspicuous phase which we recognize as the plant, while the gametophyte has become entirely parasitic. A mean, between these two extremes, is illustrated by the mosses, in which both gametophyte and sporophyte are green, so that the sporophyte, although still attached to the gametophyte during its entire life, nevertheless is partially independent. The reduction, however, is very gradual and numerous intergrades could be cited to make the series complete. The reduction of the male gametophyte is similar, but there is less difference between the extremes.

Bibliography.—Atkinson, G. F., 'College Botany'; Campbell, D. H., 'Mosses and Ferns'; Coulter, Barnes and Cowles, 'A Text-Book of Botany.'

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GAMEWELL, Francis Dunlap, American missionary: b. Camden, S. C., 31 Aug. 1857. He studied civil engineering at the Rensselaer Polytechnic Institute and at Cornell, was graduated at Dickinson College, Pa., in 1881. From 1881 to 1884 he was engaged in educational work at Peking, China, from 1884 to 1887 was superintendent of the West China Mission and from 1889 to 1900 was professor of chemistry and physics at Peking University. At the siege of Peking in 1900 he was chief of staff at the fortifications of the British embassy, was field secretary and executive secretary of the board of foreign missions of the Methodist Episcopal Church in New York from 1901 to 1908 and secretary of education for China since 1909. Since 1912 he has served also as general secretary of the China Christian Educational Association. He is editor of the *Educational Review* and member of the editorial board of the *Chinese Recorder.*

GAMING AND WAGERING. See GAMBLING.

GAMMER GURTON'S NEEDLE, a «comedie» by Bishop John Still, very popular during the 16th century, and supposed to have been the first play that was acted in the English tongue. In 1575, nine years after its appearance on the stage of the university mentioned below, it appeared in print under the quaint title, 'A Ryght Pithy, Pleasaunt, and Merie Comedie; Intytuled Gammer Gurton's Needle; played on Ye Stage not long ago in Christes College in Cambridge; Made by Mr. S[till], Master of Art.' Thomas Warton had been misled into believing that the first issue of the play from the press dated from 1551, and having so described it in his 'History of Poetry,' he misled others, who on this account took it to be the very first English comedy. 'Ralph Roister Doister,' and possibly even another comedy, had however, already appeared when Bishop Still's work was not yet in press. Readers of the present time who penetrate behind the quaint, uncouth language of this old play, will find in it an interesting picture of the 16th century village life. The plot, one of the simplest sort, turns on merely the loss of Gammer («old wife») Gurton's «needle,» as she mends her man Hodge's «breeches.» The action proceeds on the search for the needle — a search by the entire household — and the pranks of Diccon the Bedlam, a clown (the «vice» of this play) who induces a quarrel between Gurton and the neighbors; and concludes, to the discomfiture of the wearer, in the finding of the needle in exactly the place on which Gammer Gurton's industry had been employed. Lord Morley, a high authority in these matters, in an attempt at a literary evaluation, found this play — to use his own words — «indelicate, but not indecent.» It was revived successfully by Stuart Walker and the Portmanteau players in 1917. Consult Morley, 'English Writers' (Vol. VIII, 1897); and Saintsbury, 'History of Elizabethan Literature.'

GAMMON THEOLOGICAL SEMINARY, school for the training of colored men for the ministry of the Methodist Episcopal Church located at South Atlanta, Ga. Rev. Elijah H. Gammon was a Maine man who came to Illinois in 1851 for the benefit of his health and actively labored in the Rock River Conference in and around Chicago until 1858 when he retired from the ministry at the age of 39. He then entered upon a business career and became a wealthy man. He founded Gammon Theological Seminary with gifts and bequests of nearly half a million dollars, besides contributing generous sums to other causes. He died in 1891. The first dean of the seminary was Rev. W. P. Thirkield, D.D., now a bishop of the Methodist Episcopal Church. Rev. W. H. Crawford, D.D., president of Allegheny College, was a member of its faculty. Bishop Thirkield was succeeded by J. W. E. Bowen 1899–1910. Rev. S. E. Idelman, D.D., was president 1910–13. Since 1915 Rev. Philip M. Watters, D.D., has been the president. At present it has a faculty of six, an average attendance of 80 and over 300 graduates. The buildings are valued at $82,000 with the present endowment of $481,000, and a library of more than 15,000 volumes.

GAMP, Mrs. **Sairey,** in Dickens' 'Martin Chuzzlewit' (1843–44), a stout and elderly professional nurse with a watery eye and a fondness for spirits. She is loquacious and confidential, and continually refers to the opinions of a fabulous being, «my friend Mrs. Harris.» Her amorphous umbrella has furnished the name «gamp» for that type of impedimenta.

GAMTOOS (găm'tōs) **RIVER,** Cape Colony, South Africa, which rises in the plateau of Great Karoo and empties into the Indian Ocean. In 1770 this river was officially declared the eastern boundary of Cape Colony. Consult Theals, S. McC., 'History and Ethnography of South Africa before 1795' (London 1910).

GAMUT, găm'ŭt, in music, a name applied in a three-fold manner:—(a) in its original sense, to the first or lowest note of the scale; (b) to the mediæval «great scale» whereon the musical notes are disposed in their several orders; (c) to the whole range of a voice or instrument, in the modern sense of «compass.» Gamut is derived from the Greek letter Γ, γ, γαμμα, gamma, which was combined in the Middle Ages with the Latin adverb or conjunction *ut*. Thus arose «gamma ut,» which was later contracted into gamut. Ut is derived from the first syllable of the mediæval Latin hymn, «Sancte Johannes,» well-known in the history of musical development. The invention of the hexachord, the origin of which is bound up with that of the gamut, when understood to mean the great scale, is usually ascribed to Guido Aretino or d'Arezzo (q.v.) who (about A.D. 1020) designated the notes of the hexachord by the first syllables of each line of the above mentioned hymn.

Guido d'Arezzo is commonly credited with many musical improvements, mutations, the hexachord and even gamut. But in the evolution of musical notation out of the classical alphabetical system, the invention of the mediæval is more properly assigned to Hucbald (A.D. 840–932). Hucbald used lines and the first letters of the Latin alphabet as a means of fixing the intervals of the scale, and thus may have been an important forerunner of Guido d'Arezzo. (Consult Hans Muller's 'Hucbalds echte und unechte Schriften über Musik,' Munich 1884). If by the invention of the gamut (taking the word in what was probably its original sense as employed in music), one is to understand the addition of the note «G,» at the bottom of the scale, it is quite certain that this note was sung ages before the time of Guido d'Arezzo. Aristides Quintilianus (fl. circa A.D. 110) tells us that whenever a note was wanted before the προσλαμβανόμενος, or proslambanomenos (added note) (A) of the Hypodorian Mode, it was represented by the recumbent Omega (ꞷ). And S. Odo, writing in the 10th century, represents it exactly as Aretino did, by the Greek letter Γ, γ, Guido d'Arezzo himself speaks of gamma as in his time a recent addition. He writes: «In primis ponitur Γ Graecum a modernis adjectum.» It is thus certain that he was not the first to extend the scale downwards to «Γ-ut.»

Gamut in its second sense, as the name of a plan of the musical scale (from G to ℓ), was early so understood, and the plan to which it was assigned persisted as long as the hexachords were recognized; that is, down to quite recent times. They are alluded to in Shakespeare. The Greek letter, Γ, γ, was used in this plan to denote the first note, or ut, of the lowest hexachord: the lowest note of the bass stave, where the first hexachord had its starting point. The gamut (in this second sense), seems indeed to have been employed as a mnemonic system whenever it was desired to effect a change from hexachord to hexachord, according to the principles of mutation; and on this account the gamut may be regarded as the ancestor of the Tonic Sol-fa modulator. In modulating with the Tonic Sol-fa system, for example, from the tonic to the dominant, the «sol» of one bar becomes the «do» of the next, which illustrates the survival of the very principle for which the gamut once existed. Sometimes the scale is referred to as the harmonical hand, from Guido d'Arezzo's having used the figure of the hand to demonstrate the progression of his system of sounds. The understanding of the scene between Bianca and Hortensio, in the 'Taming of the Shrew' (ii. I.) is possible only when one in some measure understands the gamut. There the words «one clef, two notes have,» refer to the fact that note «B» was expressed by a natural and a flat, being in the former case the third or «mi» of the hexachord beginning at «G,» and in the latter the fourth or «fa» of the hexachord beginning on «F.» «This small circumstance was the commencement of the system of accidentals, and thus opened the door for modern modulation.» Consult Fuller-Maitland, J. A., on the 'Gamut.'

GANANOQUE, gă-nă-nōk', Ontario, Canada, a port of entry of Leeds County, 18 miles northeast of Kingston, on the Saint Lawrence River, at the point where it flows from Lake Ontario. It is opposite the Thousand Islands, and has long been popular as a summer resort. It has a fine insular public park, and manufactures machinery and farming implements. Pop. 3.804.

GÁNDARA, găn'dä-rä, Philippines, a pueblo of the island of Samar, situated in the western part of the island on the left bank of the Bachao Bangahón River. In 1900 it was almost entirely destroyed during an engagement with insurgents; before that it had a large trade. A United States military station and depot for stores is situated eight miles by river from Gándara. Pop. about 15,000.

GANDIA, gän'dē-ä, Spain, town of the province of Valencia, 45 miles southeast of the city of that name, on the Alcoy, about two miles distant from the coast. It contains many mediæval remains, old walls surrounding the town, a ducal palace, a college, churches, etc. It has silk mills, tanneries and velvet manufactories and has a good trade in the grain, rice, fruit and oil of the district, which is very fertile. Consult Calvert, A. F., 'Valencia and Murcia' (New York 1911). Pop. 12,000.

GANDIER, gän'dē-ä, **Alfred,** Canadian preacher and educationist: b. Hastings County, Ontario, 29 Nov. 1861. He was educated at Queen's University, Kingston, where he graduated B.A. in 1884, and at Edinburgh University, where he graduated B.D. in 1889. After holding charges at Brampton, Ontario (1889–93), and Fort Massey Church, Halifax, Nova Scotia (1893–1901), he was called to Saint James' Square Church, Toronto, where he labored until 1908. He was appointed lecturer on apologetics at Knox College, Toronto, in 1902, and in 1908 was elected principal of the college.

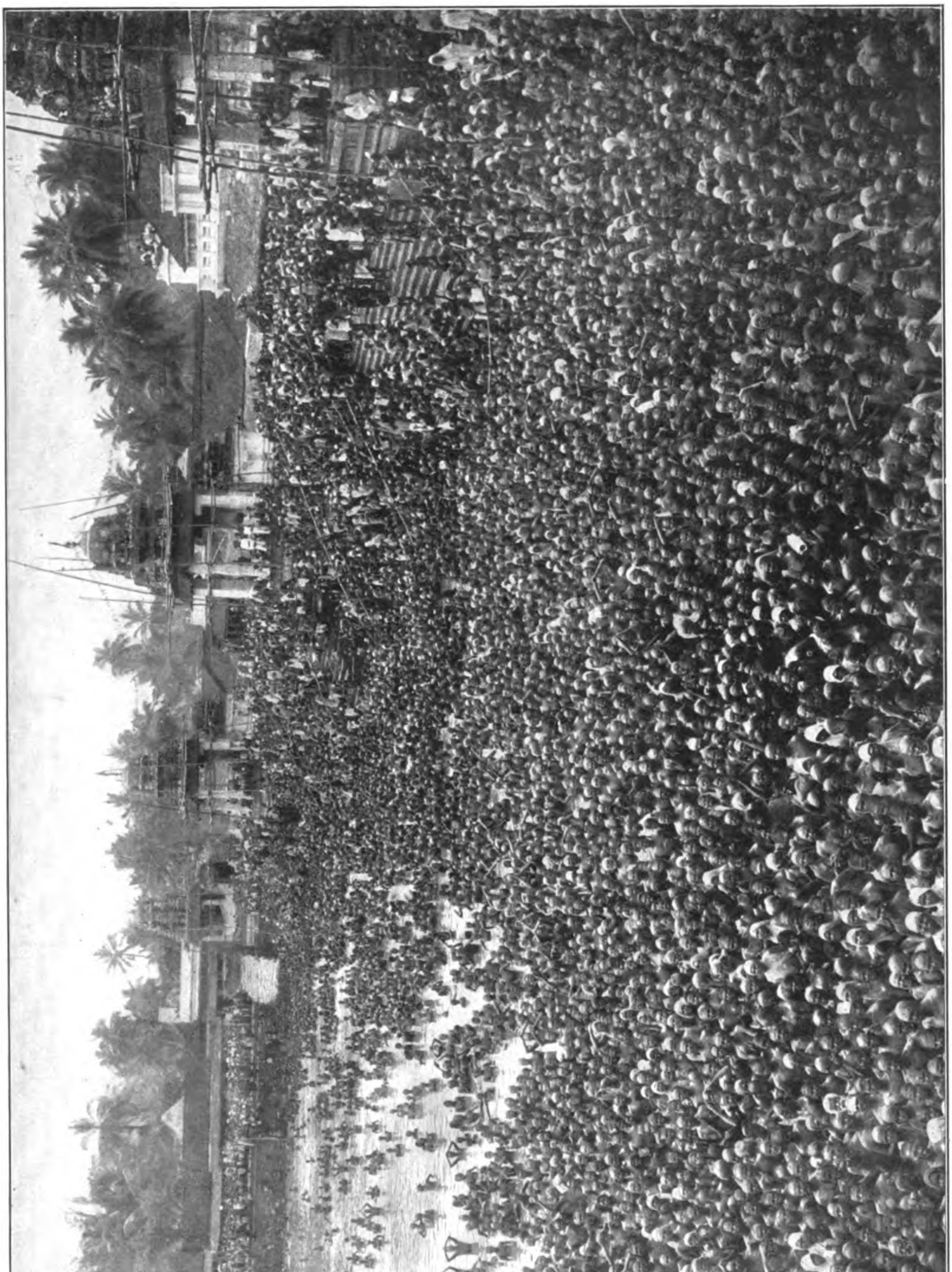
GANDO, gän'dō, Africa, a portion of the colonies of Nigeria, Dahomey and Upper Senegal and western Sudan, intersected by the Niger and inhabited chiefly by Hausas, Fulbes and Surhais. It is a most fertile district, the rain being plentiful. Mohammedanism is the prevalent religion. Pop. estimated at 5,500,000.

GANGES, gän'jēz, one of the greatest rivers of Asia, and "the sacred river of the Hindus," rises in the Himalaya Mountains, in the province of Garhwal, northern India. It is formed by the junction of two head streams, respectively called the Bhagirathi and the Alaknanda, which unite at Deoprayag, 10 miles below Srinagar, 1,500 feet above the level of the sea. The Bhagirathi which flows from an ice cave in a snow field, 13,800 feet above sea-level, is usually considered the source of the Ganges from its being a sacred stream in Hindu mythology; but the material claims of the Alaknanda are preferable, as it flows farther and brings a larger volume of water to the junction. At Hardwar, about 30 miles below the junction of the head streams, and about 120 miles north-northeast of Delhi, the river is only 1,000 feet above sea-level. Here it enters the great valley-plain of Hindustan, and flows in a southeast by south direction until it discharges itself by numerous mouths into the Bay of Bengal, a distance exclusive of windings of fully 1,100 miles. Its length, with deviations, is calculated at about 1,500 miles. During its course it is joined by a number of large rivers, the principal of which are the Jumna and Son, joining on the right bank; the Ramganga, Gumti, Gogra, Gandak and Kusi, on the left bank. Some of the principal cities on the Ganges and its branches, descending the stream, are Cawnpore, Allahabad, Benares, Patna, Behar, Murshidabad and Calcutta. The Ganges is navigable for boats of moderate size nearly 1,300 miles from its mouths. It is a great feeder of irrigation and navigation canals. (See GANGES CANAL). Its utmost breadth is about three miles, with a maximum depth of about 30 feet in the dry season, and 60 feet in the wet. Its descent is computed at four inches per mile; its current in the dry season is less than three miles an hour; in the wet season five or six. The quantity of water discharged into the ocean is estimated at 500,000 cubic feet per second during the flood season, and 100,000 during the remaining eight months of the year. Its current brings down a great quantity of mud, which in the course of ages has contributed to form the wide delta which belongs to it in common with the Brahmaputra. The delta, intersected by numerous branches, extends from east to west from 80 to 200 miles, and commences about 200 miles, or 300 by the course of the river, from the sea. A part of it is an uninhabited region called the Sundarbans, overgrown by jungle, infested with tigers and crocodiles. The westernmost deltaic branch of the Ganges, called the Hugli, is the only branch commonly navigated by ships; and vessels drawing 26 feet are safely piloted up to Calcutta. The construction of embankments, and continuous dredging, are necessary to keep a clear channel. The Ganges, as the Padna, continues eastward until it joins the Jamuna, the main branch of the Brahmaputra, which flows through the estuary of the Megna, the deltaic boundary on the east, into the Bay of Bengal. The periodical inundation of the Ganges commences about the end of April with the tropical rains. It rises gradually till it attains, near the commencement of the delta, a height of 32 feet above its ordinary level. By the end of July, the flat country of Bengal is overflowed to the extent of 100 miles in breadth, leaving visible little but tops of trees and villages, which are often built on artificial mounds above flood mark. After the middle of August the water begins to recede, and decreases till the period of the next inundation.

That part of the Ganges which lies between Gangotri, the first temple and pilgrim resort on its banks, 10 miles from its source, and Saugor Island, below Calcutta, is held particularly sacred. Wherever the river runs from south to north contrary to its usual direction, and at the junction of its affluents, it acquires a more peculiar sanctity. Its junction with the Jumna at Allahabad (q.v.) forms the most venerated place of Hindu ablution. The Hindus believe that this river rises immediately from the feet of Brahma, and that it possesses great and miraculous cleansing powers, on account of its divine origin. There is a scientific basis for this universal faith among Hindus, repeated and careful experiments showing that the river possesses extraordinary but hitherto inexplicable antiseptic qualities.

It is an imperative duty of the Hindus to bathe in the Ganges, or at least to wash themselves with its waters, and to distribute alms, on certain days. Whoever dies on its banks, having drank of its waters before his death, is thought to be exempted from the necessity of returning into this world and commencing a new life. Whenever, therefore, a sick person has been given over by the physicians, his relations hasten to carry him to the bank of the Ganges, in order that he may drink of the holy water, or be immersed in the river. Such as live too far from the river to admit of this always preserve some of the precious water, as a sacred treasure, in a copper vessel, that it may be given them in the hour of death. This water is, therefore, a considerable article of commerce in India. It is also customary, after the dead have been burned, to preserve the remains of the bones and the ashes until an

GANGES



Bathing in the Ganges

opportunity offers of throwing them into the Ganges.

The name Ganges signifies merely *the stream* (Sanscrit *Gangâ*). In Hindu mythology the river, personified as the goddess Gangâ, held a position equal in importance and interest to that which *the stream* (the stream par excellence) holds to-day.

GANGES CANAL, The, in India, an important irrigation work and navigable channel, the older portion called the Upper Ganges Canal, opened in 1854, and extending on the right of the Ganges (q.v.) from Hardwar to Cawnpore and Etawah, with a main canal 440 miles long, navigable throughout: and with 2,634 miles of distributaries. The Cawnpore and Etawah terminal lines are now absorbed in the Lower Ganges Canal, commenced in 1873 and completed in 1878, which continues in its main branch for 260 miles to Allahabad, drawing its supply from the river at Narora, in the Aligarh district. The weir and headworks at Narora include a solid wall, 3,800 feet long, with 42 weir sluices, founded on huge square blocks.

GANGHOFER, gäng'hōf-er, **Ludwig,** Bavarian poet, dramatist, novelist and statesman: b. 7 July 1855 at Kaufbeuren. He was the son of August G. (1826–1900), who bore the title of Oberforstrat and was the author of several useful books on forestry. As a youth he showed ability in mechanics and was trained in the technique of machinery. He studied philosophy, philology and the natural sciences at Würzburg, Munich and Berlin. But after 1879, making his début with a volume of lyrics, he devoted himself entirely to literary activities, taking up his residence in Leipzig. The following year he issued his translation of De Musset's 'Rollo.' He continued pouring forth poems, collecting them from time to time under the titles 'Bunte Zeit' (1883); 'Heimkehrer' (1884); 'Es War Einmal: Moderne Märchen' (1891); 'Fliegender Sommer: kleine Erzählungen' (1893) and 'Die Sünde der Väter,' (1886), the last reaching its seventh edition in 1902. He then turned his attention to dramatic writing and attained his first success with 'Der Herrgottschnitzler von Ammergau' which he wrote for the Wandertruppe of the Munich Dialect Theatre and which was played with Hans Neuert in the chief part in 1880. In 1881 he was invited to Vienna to become Dramaturg for the Ringtheater. From 1886 until 1892 he was editor of the feuilleton of the *Wiener Tageblatt.* But when the theatre was burned the stock company was scattered. His first successful play was published in 1890 in the 'Neuer Novellenschatz' with illustrations by Engel and in 1901 had reached its 10th edition. Among his other plays were 'Der Prozesshansl' (1884); 'Der Geigenmacher vom Mittelwald' (1884; new ed., 1900) and in collaboration with Marco Brociner, 'Die Hochzeit von Volini' (1889; 3d ed., 1905); 'Die Falle' (1891); 'Auf der Höhe' (1892). He also wrote the five-act drama 'Wege des Herzens' and a one-act comedy, 'Der Anfang vom Ende.' Having an intimate knowledge of the Bavarian mountain-forests and the dialect of the people living there, he found among them an inexhaustible source of tales and romances. The best known of the 'Tales of the Highlands' are 'Der Jäger von Fall' (1882); 'Almer- und Jagerleut' (1885); 'Edelweiskönig' (1886); 'Oberland' (1887); 'Der Unfried' (1888); 'Die Fackeljungfrau' and 'Doppelte Wahrheit' (1893); 'Rachele Scarpa' and 'Tarantella' (1898); 'Das Kaser-Mandl' (1900). The titles of the longer romances, some of them in two volumes and illustrated with characteristic vignettes, are 'Der Klosterjäger' (1894) 'Die Martensklause' (1894); 'Schloss Hubertus' (1895); 'Die Bacchantin' (1896); 'Der laufende Berg' (1899); 'Das Schweigen im Walde' (1899); 'Der Dorfapostel' (1900), and 'Das neue Wesen' (1902). The rather difficult dialect in which much of the dialogues in these dramatic and fascinating novels is cast is undoubtedly the reason why they have never been translated into English, as they well deserve to be. Ludwig Ganghofer has of later years been one of the most trusted counsellors in the entourage of Kaiser Wilhelm, although in a strictly private capacity.

NATHAN HASKELL DOLE.

GANGLION, connective tissue membranes enclosing small amounts of clear synovial fluids. They are usually found where tendons or muscles glide over bony parts, or where the skin, muscles or fascia are subjected to pressure or to friction. The number, size and location of these structures are subject to much individual variation. One of the commonest is found on the back of the hand, at the wrist, particularly in people who stretch their fingers widely, as piano players, or as librarians who handle many books, grasping several at a time. In this form is a firm and painless swelling, liable to be caused by any excessive exercise of the wrist, as in playing tennis, golf, etc. This swelling gives the impression that there is fluid beneath the skin, and grandmother's advice to break it with the family Bible or the dictionary is often followed, sometimes with serious results. This forceful method of reduction is foolish, as most of the swellings disappear with rest and the application of heat. If they persist, a surgeon should be consulted. Another very persistent variety of this trouble is found in the knee — causing housemaid's knee, or miner's knee. Obviously the breaking of these tumors by force is out of the question. There are many places in the body in which similar collections of fluid may accumulate, but these rarely cause much inconvenience unless they become infected through some knock or cut. In this event prompt surgical treatment is advisable, and aseptic surgery should be insisted on. A careless and unclean surgeon may render a limb useless.

GANGOTRI, gän-gō'trē, a square temple, about 20 feet high, erected on the right bank of the Ganges (q.v.), which here forms a small bay; about 10,319 feet above the level of the sea. This spot is regarded by pilgrims as the source of the holy stream, here called the Bhagirathi, which, however, rises eight miles higher up. The water here is peculiarly sacred, but few pilgrims come so far, and the only dwelling-house in the locality is occupied by the officiating Brahmins, by whom flasks of the holy element are sealed for conveyance to the plains.

GANGRENE, găn'grēn, the term applied to death of soft tissue in masses large enough to be seen. There are two forms, differing in causation, appearance and progress. Dry or senile gangrene results from the gradual occlusion of arteries, the venous return being unimpaired. For weeks or months the toes and feet, the parts most frequently affected, may feel cold or numb, or be actually painful, then gradually the skin becomes dry, then purple and black. The spread is usually very slow. It is particularly a disease of old age, due to the tendency at that period of life toward thickening and stiffening of the arterial walls. Moist gangrene results from sudden stoppage of the arteries, obstruction of veins, mechanical destruction of the issues or from specific infection by germs. It is generally due to an injury which destroys a part of the living flesh, as in wounds, frostbite, burns by fire or corrosion by acids, etc. It also follows carbuncles and bedsores in some cases, and has occurred as the result of a tourniquet too vigorously applied or left on too long. This form shows a soft, boggy, bluish mass covered with blisters and emitting the odor of putrefaction. In both forms of gangrene there may be a zone of inflammation between the dead and the living tissue, called the line of demarcation. The dead flesh may separate naturally leaving a scar on the healthy tissue, or the separation may have to be made by amputation of the diseased part.

Hospital gangrene was formerly very prevalent in military hospitals; a wound becoming infected would quickly change to a gray slough, which in a few hours might involve the entire limb unless prompt removal of the tissue was undertaken. Aseptic surgery has made this fatal disease a thing of the past. Spreading gangrene is due to infection by a specific germ, the bacillus of malignant œdema, so called from the fact that it generates a gas that puffs up the tissue affected. The spread is rapid, and life is sometimes saved by amputation far above the wound. The treatment of gangrene is usually a matter of amputation, well beyond the affected part. Careful aseptic dressing is imperative, particularly where the condition of the patient is apt to contra-indicate radical cure.

GANGUE, găng (Ger. *Gang,* a vein), the matrix or veinstone of ores. These are always included in some stony matter, which forms the principal portion of the veins or beds which are worked for the sake of their metalliferous contents. Quartz is the most common veinstone, and has been called the mother of ores. Calcareous spar, calcite, is also a frequent predominant material of veins. Sulphate of barytes or heavy spar, and fluor spar, are also often found as gangues.

GANISTER, a name originally given in England to a particular clay high in silica, used in the manufacture of fire-brick. In this country the term is used more loosely and includes non-plastic rocks that are not clays at all but approach sandstones in character. Ganister may, therefore, be defined as highly silicious material used in the manufacture of fire-brick, more particularly what are known as silica-brick, for lining blast-furnaces, Bessemer converters, etc. The manufacture of such brick is an important industry in western Pennsylvania. See CLAY.

GANNAL, gä-näl, **Jean Nicolas,** French chemist: b. Saarlouis, Prussia, 28 July 1791; d. Paris, January 1852. He is noted for his invention of the method of embalming by injection.

GANNETS, large sea-birds constituting the family *Sulidæ,* of the order *Steganopodes,* characterized by having all the toes connected by webs, the absence of external nostrils and a very short tongue. They are closely related to the pelicans and cormorants, have large powerful bills and feed upon fish, frequenting the sea-coasts of various parts of the world. The common gannet (*Sula bassana*), to which the name properly refers, is restricted in the breeding season to a few rocky islets on the coast of the British Isles and Iceland — notably the Saint Kilda group, and to Bird Rock in the Gulf of Saint Lawrence; and their numbers have been much diminished by the fishermen who gather their eggs for food. They nest in colonies among the crevices and ledges of the rocks, and each bird lays a single large chalky white egg. When the young are on the wing they all leave together and scatter widely in search of food, extending their range on our coasts as far as the Gulf of Mexico. In the southern hemisphere are two closely related gannets. *S. serrator* of Austria and *S. capensis* of South Africa. Eight other somewhat smaller species, called "boobies" (q.v.), breed on various tropical islands. The common gannet is pure white with black outer wing-feathers and a buffy suffusion on the head. The young are mottled grayish brown. The other species are similar, many of them with red and blue coloring on the bare skin of the throat and around the eye.

GANNETT, Ezra Stiles, American Unitarian clergyman: b. Cambridge, Mass., 4 May 1801; d. near Boston, 25 June 1871. He was graduated from Harvard in 1820, in 1824 became assistant to W. E. Channing at the Federal Street Church, Boston, and later succeeded to the pastorate. In the Unitarian controversies of 1825–35 he took a prominent though conservative part. He was the first secretary of the American Unitarian Association, its president 1847–51 and president of the Benevolent Fraternity of Churches 1857–62. He was also founder and editor of the *Scriptural Interpreter,* and an editor of the *Christian Examiner* and the *Monthly Miscellany of Religion and Letters.*

GANNETT, Henry, American geographer: b. Bath, Me., 24 Aug. 1846; d. 5 Nov. 1914. He was graduated at the Lawrence Scientific School in 1869; became geographer of the United States Geological Survey in 1882; was geographer of the 10th, 11th and 12th censuses, and of those taken by the War Department in Cuba and Porto Rico in 1899. His publications include 'Manual of Topographic Surveying' (1893); 'Statistical Atlases, 10th and 11th Censuses'; 'Dictionary of Altitudes' (3d ed., 1899); 'Commercial Geography'; 'The Building of a Nation' (1895); 'Gazetteer of Cuba' (1902); 'Gazetteer of Texas' (1902); 'Origin of Certain Place Names in the United States' (1902).

GANNETT, William Channing, American Unitarian clergyman: b. Boston, Mass., 1840. He is a son of E. S. Gannett (q.v.). He has held Unitarian pastorates at Saint Paul, Minn., and other places, and is now pastor emeritus at Rochester, N. Y. He is the author of 'A

Year of Miracle' (1881); 'Memoir of Ezra Stiles Gannett' (1875); 'The Thought of God in Hymns and Poems' (with F. L. Hosmer, 1885, 1904); 'The Faith that Makes Faithful' (with J. Ll. Jones, 1886); 'Of Making Oneself Beautiful' (1899); 'The Childhood of Jesus' (1884), and other books.

GANODONTA, a group of primitive mammals regarded as ancestral to the edentates, whose remains are found in the lowest Eocene formations of the western United States. These remains are not numerous nor complete, but plainly exhibit a progressive relationship toward modern Edentata (q.v.). The earliest known is *Hemiganus*, from the Puerco beds of New Mexico, which was as big as a medium-sized dog. A later genus of similar size is *Psittacotherium;* and a still later (Lower and Middle Eocene) is *Stylinodon*. In reviewing the series, says Beddard, we see a gradual diminution of the incisors, a gradual loss of enamel on the teeth generally and the production of hypsilodont teeth growing from persistent pulps, all of which are features of the later edentates. The progression is gradual, but the forms seem to be a continuous series culminating in the ground-sloths. (See PALÆONTOLOGY). Consult Wortman, 'The Ganodonta,' in *Bulletin of the American Museum of Natural History* (Vol. IX, New York 1897).

GANOID FISHES, an order of fishes founded by Agassiz on the character of the scales of certain fossil fishes, which are bony and lustrous, now regarded as a group-name for a rather heterogeneous series of low and chiefly extinct fishes. They are distinguished from the Clasmobranchs by their scales, their possession of true bone and of an air-bladder, and from the teleosts or true fishes by the possession of a spiral valve and a contractile bulbus arteriosus and the absence of decussation in the optic nerves. (See ICHTHYOLOGY). The ganoids were most numerous in Palæozoic and early Mesozoic times, and few and diverse are the surviving forms, which include the paddle-fishes and sturgeons, the gar-pikes, the mud-fishes of the African rivers and a few others, all elsewhere described. In this group fall some of the most famous fossil fishes of palæontology, described by Hugh Miller in his 'Old Red Sandstone' and otherwise introduced long ago to the public. The berry-bone (*Coccosteus*), the seraphim (*Pterichthys*) and the *Asterolepis* also had a bony shield, the flexible trunk having scales in *Pterichthys*, being naked in *Coccosteus*. The anterior limbs, or pectoral fins, of *Pterichthys* were long, covered with closely fitted plates and had a complex joint connecting them with the thorax. The gar-pikes of the American lake region are the modern representatives of the *Lepidotus, Æchmodus*, etc., of Mesozoic strata and of the Carboniferous *Palæoniscus*. *Polypterus*, the type of this group, is confined to the Nile and a few other African rivers. The group is most abundant in the Palæozoic strata, *Dipterus, Osteolepis, Holoptychius, Phaneropleuron*, being Old Red Sandstone genera; *Rhizodus, Megalichthys* with rhomboidal scales, *Strepsodus* with cycloid scales, Carboniferous. The cœlacanths range from the Carboniferous to the Chalk formations, and are the only members of the order in which the tail is homocercal.

The Ganoids are not a homogeneous group. The *Crossopterygii*, whose sole extant representatives are *Polypterus* (see BICHIR) and *Calamoichthys* from equatorial Africa, stand close to the common origin of the other Ganoid stocks, the teleosts, or ordinary bony fishes, and the dipnoi. The *Chandrostei*, including the sturgeons and spoon-bills, stand later palæontologically and in their degree of specialization, but show some interesting resemblances to the sharks and rays. Still later in their degree of development and definitely on the track of teleost evolution are the *Holostei*, of which the bow-fin and gar-pike survive.

GANONG, William Francis, Canadian historian and botanist: b. Saint John, New Brunswick, 19 Feb. 1864. He was educated at the universities of New Brunswick, Harvard and Munich. He was assistant professor of botany at Harvard 1887–89; instructor 1889–93; and since 1893 has been professor of botany and director of the botanical garden at Smith College, Northampton, Mass. Among his works are 'The Teaching Botanist' (1899); 'Laboratory Course in Plant Physiology' (1901); 'The Living Plant' (1913). He has written a number of monographs on the history of the Maritime Provinces and has translated and edited for the Champlain Society Denys' 'Natural History of Acadia' (1908); Le Clercq's 'New Relation of Gaspesia' (1910).

GANSEVOORT, gän'sę-vórt, **Johan Wessel,** Dutch theologian and ancestor of American families: b. Groningen, Netherlands, 1420; d. 4 Oct. 1489. Educated at Deventer in the school of the Brothers of the Common Life, he came also under the influence of Thomas à Kempis at Zwolle. As student or teacher, he spent some years in Cologne, Paris, Rome, Basel and Heidelberg, becoming versed in Hebrew, Greek and Latin, and in contact with many minds and the ablest men of his day. His fame as a renowned teacher of philosophy and theology was over all Europe. Eschewing strife and declining ecclesiastical honors, he returned to Groningen to spend the remainder of his life amid many disciples and as director of the cloister of the Spiritual Virgins. His theology was of the mystical and mediæval type, yet he is justly reckoned a "reformer before the Reformation." In 1521 Martin Luther published a collection of his writings, declaring that his own ideas had been already contained in the writings of Gansevoort, whose views on the sacraments, however, were those of Zwingli. Various editions of Gansevoort's works in Latin, Dutch and German have been published, but the first complete translation into English, with biography and comments, was made in New York 1917. He was the ancestor of the family of the same name in New Netherland and New York, including Colonel Gansevoort (q.v.) of Continental and Revolutionary fame. Consult his biography and writings (1917).

GANSEVOORT, gans'voort, **Peter,** American officer: b. Albany, 17 July 1749; d. there, 2 July 1812. In 1775 he joined the army which under Montgomery invaded Canada, and in 1776 he was appointed to the command of Fort George. In 1777 he was placed in command of Fort Stanwix, which he gallantly defended against a vigorous siege of 20 days by British and Indians under St. Leger, and received the thanks of Congress for having thereby prevented the co-operation of that general with Burgoyne, and contributed to the defeat of the latter. In 1781 the State of New York raised him to the rank of brigadier-general, which he held till the termination of the war. He afterward filled various important offices under the Federal government. He was successively commissioner of Indian affairs, commissioner for fortifying the frontiers and military agent. In 1809 he was appointed brigadier-general in the United States army.

GANSS, Henry George, American composer: b. Lancaster, Pa., 22 Feb. 1855; d. there, 25 Dec. 1912. He was educated at a parochial school in Lancaster, Saint Vincent's College, Latrobe, Pa. He was ordained to the Catholic priesthood in 1878 and from 1878 to 1881 was curate at Lykens, Pa. In 1881–86 he was rector at Milton and from 1890 to 1910 was rector of Saint Patrick's, Carlisle, and spiritual director of Catholic Indians in the Carlisle Indian School. In 1910–12 he was rector of Saint Mary's Church, Lancaster. He has been much interested in the Carlisle Indians and has done much to ameliorate their position. His musical compositions include 'First Mass in D,' with orchestra; 'Second Mass in D,' with orchestra; 'Fourth Mass in C'; 'Requiem in D Minor'; 'The Banner of the Sea,' hymn of the navy; 'Long Live the Pope,' hymn, translations in 25 languages. He has published 'Mariolatry: New Phases of an Old Fallacy'; 'History of Saint Patrick's Church, Carlisle, Pa.'; pamphlets on the Reformation, Anglican orders and on Indian questions. He was a contributor to 'The Catholic Encyclopedia,' *The Messenger,* the *American Catholic Quarterly Review,* the *American Ecclesiastical Review,* the *Ave Maria,* etc.

GANYMEDE (Gk. Γανυμήδης; Lat. *Ganymedes*), in Greek mythology the son of Tros and of Callirrhoë, a daughter of the Scamander. Zeus sent his eagle from heaven, which carried him off from Mount Ida to the seat of the gods, where he discharged the office of cup-bearer to the immortals, Hebe having rendered herself unworthy of this office. This fiction has afforded, both to poets and artists, an inexhaustible supply of subjects. Numerous paintings, statues, cameos and intaglios, masterpieces of ancient art, have descended to us, upon which this youth, scarcely past the years of boyhood, is represented as of great beauty. The representations of Ganymede are to be recognized by the Phrygian cap and the eagle, which is either standing beside him or carrying him in his talons to Olympus. Ganymede was identified with the Nile god who presided over the source of the river, and seems to have been originally one of the water gods and the sender of water upon the earth. He was also identified with Aquarius (the waterman) among the stars and was said to have the honor of being the cup-bearer of the immortal gods.

GANZ, gänts, **Rudolf,** Swiss composer: b. Zürich, 1877. He studied in his native city under Freund and Hegar, and appeared in public as a 'cellist at the age of 10. From 1893 to 1896 he paid especial attention to piano and composition, being instructed in the former by Eschmann-Dumur and in the latter by Blanchet. At Strassburg he prosecuted his studies under Blumer, and later removing to Berlin studied there under Busoni and Urban. In 1899 he made his début in the German capital and soon afterward came to the United States, where he remained for 13 years, being chief of the piano department at the Chicago College of Music from 1900 to 1905; from the latter year he went on the concert stage, playing all over the country with the great symphony orchestras and meeting everywhere with the greatest success. He is the author of a symphony in E; concertstuck for piano in B; several male choruses; piano pieces, and about 150 songs. His concert numbers have avoided the beaten path, presenting as a rule little known but meritorious works, whether of old composers or of recent writers struggling for recognition.

GANZ, Wilhelm, eminent musician: b. Mainz, Germany, 6 Nov. 1833; d. London, 12 Sept. 1914. At the age of 15 he came to London with his father, who was chorus master at Her Majesty's Theatre. In 1850 he definitely settled in London as an accompanist, in which capacity he acted for Jenny Lind in England and Scotland. He was a church organist for some years and also played the violin in the New Philharmonic Orchestra in 1852, of which he became conductor in 1874. In 1884 Ganz turned his attention to the teaching of singing, and up to his death was a professor at the Guildhall School of Music. He had a jubilee concert at the Albert Hall in 1898 to celebrate the 50th anniversary of his first visit to England, and a diamond jubilee concert in 1908. A number of leading sopranos — including Patti — preferred his style of accompaniment to that of more strenuous players.

GAP, France, capital of the department of Hautes-Alpes, on the Luye, 2,418 feet above sea-level, 50 miles from Briançon and 85 from Grenoble. It contains a fine cathedral, entirely reconstructed in 1866–1905, an episcopal palace, the tomb of the constable de Lesdiguières, a lyceum, library, a prefecture containing scientific and archæological collections. Gap has a few small manufactories, including those of hats, leather, cement, etc. The town was founded as Vapincum by Augustus in 14 B.C. It was long a part of Provençe but passed to the dauphins of Viennois in 1232. From the 5th century it was an episcopal see and its bishops for a time (1232–1512) ruled the district. In 1512 it was annexed to the Crown of France. It is the birthplace of Guillaume Farel, the reformer. Pop. 11,000. Consult Roman, J., 'Histoire de la ville de Gap' (Gap 1892).

GAPÁN, gä-pän', Philippines, a pueblo of the province of Nueva Ecija, Luzon, situated four miles east of San Isidro, the capital. It is at the junction of several roads, and is the largest town in the province. Pop. about 12,000.

GAPER, gą'- or gä'per, a name given to many animals who have great mouths, or in some other way suggest gaping. Thus it is one of the British names for the European soft clam (*Mya truncata*) in reference to the wide separation of the shells, as is characteristic of deeply burrowing bivalves; and it is applied to relatives on the Pacific Coast of the United States. Among birds, the broadmouths (q.v.) are called gapers; and among fishes some of the sea-bass, which open their mouths in dying to the widest extent.

GAPES, a disease of young poultry, caused by a parasitic nematode worm in the throat. See POULTRY, DISEASES OF.

GAPON, George, Russian revolutionist: b. Biliki, Poltava, about 1870; d. 1906. He studied theology, entered the priesthood and worked as a missionary among the poor people of Saint Petersburg. He set about organizing labor unions and the better to further this end secured the consent of the Russian secret police to the project. This was about 1903; in April of the following year the Industrial Workers' Association of Saint Petersburg was formally launched and many branches were formed in the capital and suburbs. In December Gapon, who had come under the influence of the Zemstovs, began a systematic propaganda for a general strike as an aid to the reform movement which was then sweeping Russia. He secured a large following and was a prominent figure in the troubled year of 1905. He escaped from Russia, reached London and there wrote an autobiography which was published in the *Strand Magazine*. His subsequent activities are shrouded in mystery. On 11 April 1906 the body of a man, who had either been hanged or had committed suicide, was found in a villa near the capital and was identified as that of Father Gapon. About a month afterward the newspapers of the capital published a letter forwarded them from Berlin, in which it was alleged that Gapon had betrayed his associates by returning to Saint Petersburg and agreeing to reveal the activities of the revolutionaries to the authorities; for this he was marked for death by the latter, who succeeded in carrying out the decree. Consult Gapon, 'Story of My Life' (London 1905).

GAR, GARFISH, or GAR-PIKE, one of two sorts of fish, both long and slender, with a prolonged spear-like snout filled with teeth, and hence bearing such local names as "bill-fish," "needle-fish," "bony-pike," etc.; and "greenbone," because of the greenish tinge on the bones. The group originally called "gar" was that of the family *Belonidæ* (or *Esocidæ*), allied to the sauries and flying-fish, the type of which is the common European *Belone belone*. This is a swift, voracious fish which darts along the surface picking up little fishes, and especially playing havoc in shoals of young mackerel. It is usually about two feet in length, is often brought to the London market, and forms a wholesome dish, in flavor somewhat like mackerel. The young forms have at first jaws of a normal size, but in growth the lower outstrips the upper. Very similar, but larger, are the "silver" gars, "agujas" or "needle-fish" of American tropical waters, which offer good sport by their speed and strength, but are hated by practical fishermen whose nets they frequently destroy or damage by their effort to get at imprisoned prey. There are several species, all of the genus *Tylosurus*.

Both these kinds, as well as their Oriental representatives, are often called "gar-pikes" from their pike-like form and voracity; but in the United States this term is suitably reserved for a very different kind of gar, not known in the Old World, and a relic of the ganoid tribe prevalent in the palæozoic seas. This gar-pike represents the family *Lepidosteidæ* (see ICHTHYOLOGY), and has a long almost cylindrical body encased in an armor of white, bony, enameled rhomboid plates, which are imbricated in oblique rows running downward and backward. The jaws are long, narrow and furnished with sharp teeth, each of which fits into a depression in the opposite jaw; and are covered with a granulated shagreen-like integument. They have the air-bladder subdivided and used in respiration; no spiracle; strong fins, a heterocercal tail; swim well, and prey upon small fishes. Their own flesh is not edible and they interfere with fishing, and therefore are destroyed freely. They inhabit the rivers and lakes of North America, where the commonest species is the long-nosed gar (*Lepidosteus osseus*). Another, more southerly, is the short-nosed gar (*L. platystomus*); and a great and powerful subtropical species (*L. tristœchus*), reaching 8 or 10 feet in length, and called "manjuari" in the West Indies, is known as "alligator-gar" in the lower Mississippi district. Another species occurs on the west coast of Central America; and another in the rivers of China.

All these gar-pikes frequent shallow, reedy or grassy places, basking in the sun like the pike, and devouring living prey with great voracity. The manner of seizing prey differs from that usually observed in fishes, and resembles that of reptiles; instead of taking their food at once with open mouth and swallowing it immediately, they approach it slyly and sideways, and then, suddenly seizing the fish or other animal, hold it until by a series of movements it is placed in a proper position for being swallowed, in the manner of alligators and lizards; the ball of food is also seen to distend the body as it passes downward, as in snakes.

GAR-PIKE. See GAR.

GARABIT, gă-rä-bē, France, in the department of Lozère, is a picturesque locality on the railway from Marvejols to Neussargues, where the line spans a gorge of the Truyère River, about 10 miles south of Saint Flour. The viaduct planned by M. Eiffel is 1,852½ feet long, and is built partly of girders and partly of masonry. Where it crosses the river at a height of 401 feet, it is supported by an arch, with a span of 541 feet 4 inches. Consult Eiffel, 'Le Viaduc de Garabit' (1889).

GARANCINE, găr'ạn-sĭn, is prepared from the ground root of *Rubia tinctorum* or madder (in French *garance*) by washing it with 8 or 10 times its weight of water acidulated with sulphuric acid, 1 part of acid being used for 100 parts of powder. After digesting for seven or eight hours the fluid is run off and the paste is boiled for two or three hours by steam with more acid, and then the mass is thrown into cold water contained in a large trough with a perforated bottom covered with cloth to act as a filter. Here it is washed till all the acid is got rid of, and the paste is afterward pressed, dried and ground to fine powder. It is used for dyeing, and has the advantage over madder (q.v.) of containing a large proportion of coloring matter. It is preferable to madder for mixing with other dyestuffs to produce chocolate and some other shades.

GARAY, gä-rī, **Juan de**, Spanish soldier: b. Badajoz, 1541; d. South America, 1584. About 1565 he went to South America, where he became secretary to the governor of Paraguay, was sent on a voyage up the Paraná, discovered a vast territory and founded near the river the town of Santa Fé de Vera Cruz. He defeated the Charruas Indians not far from the Uruguay, received the commission of lieutenant-general and was appointed (1576) governor of Asuncion. In 1580 he refounded the city of Buenos Aires on its previous site, and subsequently did much to improve the condition of neighboring native tribes. Having landed in an unfamiliar region on a journey up the Paraná to Asuncion, he was there killed by hostiles.

GARBAGE is kitchen refuse and table waste, offal or discarded material from the preparation and use of human food. Assembled, it is an ever-varying mixture of animal and vegetable food waste, the nitrogenous or proteids being largely in excess of the non-nitrogenous properties. Garbage decomposes rapidly in the open air and becomes offensive, especially in warm weather. When thrown upon the ground and allowed to decompose, or when used as a fertilizer in a raw state, it may contaminate sources of water supply, and thus become a menace to public health; but, contrary to the popular belief, the garbage heap does not generate bacteria — they die when exposed on the garbage pile. In country districts and in most towns and small cities much garbage is used as food for domestic animals, and when fresh no more proper disposition of it can be made. When the material is allowed to become partially decomposed before feeding, and where caustic solutions are used for the cleansing of cooking utensils, etc., the mortality precludes its use. American cities produce from one-half pound to one pound per day per capita. European cities produce less than one-half of this amount. Analysis of American city garbage shows moisture, 70 per cent to 80 per cent; grease, 2 per cent to 3 per cent; and solids, principally wood fibre, 18 per cent to 28 per cent. Garbage from European cities contains more of solids and less of moisture and grease.

Previous to 1900 the garbage problem was a serious trouble to officials and boards of health in American towns and cities. The thoughtless citizen throws it in the street, or leaves it in his back yard until his neighbors rebel, or he burns it in his range or furnace and has more trouble with his neighbors. He puts it with ashes and other refuse and it is dumped on a vacant lot, or a depression in the ground is filled with it, and injunction proceedings are brought by near-by residents; protests and complaints of every description are made to councilmen, heads of departments and boards of health. Newspapers take it up and everyone who can possibly be held accountable is abused. The first attempts at collection and disposal in a community are apt to be crude and imperfect. All kinds of household wastes are put together in boxes or barrels and teams are hired to cart it away. In some cases the city owns the horses and wagons required for the work. This lasts until there is no longer a dumping place within hauling distance. In a few instances it has been taken to sea in scows and dumped in deep water. This is found objectionable, as the lighter portions float to shore. Total destruction of the material is the next resort. Inventors and promoters take advantage of the situation, and it is proposed to burn or utilize the material at huge profit. Corporations are formed, stock is sold and plants are built for final disposal. Then there are indignation meetings and injunction proceedings. No one wants a garbage-disposal plant near his property. Should it be completed and started, it is generally closed within a year, either by injunction or owing to the lack of funds for its operation. The country is strewn with such wrecks.

It has been found that when garbage is mixed with ashes, paper and other household waste, final disposal is rendered very difficult, the mass being unfit for filling, fuel or fertilizer. Numerous American cities separate household waste into three parts, namely, «food waste,» «combustible waste» and «non-combustible waste.» By this means final disposal is more readily effected, each class of waste having properties of commercial value when kept separate from the others. Most European cities do not attempt a separation, excepting it be at the plant where final disposal is effected. In some cases the whole mass is passed through what are termed «destructors,» burning the unconsumed carbon found in the ashes and the combustible portions of other household waste. This system of final disposal has not been found satisfactory in American cities, and has been equally unsatisfactory in some European cities, particularly on the Continent, where, as in America, it is found that much additional fuel is required in order to maintain a proper temperature in the furnaces.

It would scarcely be possible to name in this connection all those who have contributed to the development of principles, systems and apparatus which go far toward the practical solution of this difficult problem. Boston installed the first modern refuse-sorting plant, and the first reduction plant was at Buffalo. Much impetus was given to effective practical development of the principle of utilization by the determined efforts of the late Col. Geo. E. Waring, New York's indomitable commissioner of streets. After a most exhaustive investigation of the whole subject, and a thorough inspection and test of every system of disposal then in existence, both in Europe and America, Colonel Waring became thoroughly convinced that utilization was right in principle and practice, and proceeded at once to have the garbage of the city of New York disposed of in this manner.

Prior to this time there were successful utilization plants in Philadelphia, Pa., Saint Louis, Mo., and Detroit, Mich. The system adopted by Colonel Waring, and which is now in use in many of the principal cities of the United States, is first, thorough sterilization by subjecting the material to the action of live steam in enclosed vessels, condensing all vapors and passing insoluble gas through flame. By this treatment the structure of the material is broken down,— even bones are disintegrated,— the liquids carrying the oils and greases being separated from the solids by mechanical means. The further preparation of the ingredients, by which they are put in commercial form or finally disposed of, varies greatly in the different plants. In some cases the liquids are evaporated, in others they are allowed to run into sewers or water courses. In a number of the plants the solid portions are used for fuel; in others they are acidulated or dried and prepared as a base for commercial fertilizers. The greases are sometimes extracted by the use of a solvent, and reclaimed by evaporation, the solvent vapors being condensed and also reclaimed to be used again. The principles involved are not new, having been applied for many years to the treatment of slaughter-house waste. In its application, however, to the greater subject of garbage disposal, much new apparatus has been invented, and the plants have been equipped to handle very promptly a vast amount of the material; the plant which disposes of the entire garbage of the Greater New York having a daily capacity of more than 2,000 tons, and the plants located in Philadelphia, Pa., Boston, Mass., Newark, N. J., Baltimore, Md., Washington, D. C., Detroit, Mich., Saint Louis, Mo., Cleveland, Ohio, Columbus, Ohio, and in some of the smaller cities, are of sufficient capacity to dispose of all the garbage produced within 12 hours of delivery at the plant. It is this prompt and effective disposal that has rendered the utilization systems so popular in the large American cities. The entire work of collection and disposal is, in most cases, done by contract. The plants are owned by contractors, the cities in some cases collecting the garbage and delivering it upon the contractors' cars or boats for transportation to the place of final disposal.

Garbage collection is now common in all American cities and towns of 10,000 or more population, and is increasing in smaller places. It has been found that a collector making rounds once a week can serve 40 to 90 houses a day. Usually two men travel to a wagon, and the use of specially designed sheet-iron body wagons is increasing. It is common to ask householders to separate their garbage and ashes and refuse in separate cans, so that the collectors can conveniently dispose of them. The ashes can then be used for filling low land, which would be impracticable if mixed with garbage. Where there are incinerator plants there is a tendency to return to the old method of dumping all the garbage, ashes and refuse together, and taking it to the incinerating furnace. Here the unburned coal in the ashes and the wood in the refuse furnish fuel enough to consume all the moist garbage. Cities and districts are routed, and householders notified what days the collectors will come through their streets, and on such mornings they place their garbage cans on the sidewalks.

Incinerators or destruction plants are increasing in use. Seattle has five 60-ton destruction plants, distributed so as to reduce haulage, and pays \$1.94 per ton for collecting the garbage. Incineration costs only seven and one-half cents a ton. Figuring in depreciation, interest and all costs, the total expense is about \$3 per ton. One of the largest incinerator plants is in Columbus, Ohio; capacity 80 tons in 12 hours. The garbage is collected in steel wagons, 50 horses being employed in the hauling. Ashes are utilized to fill in low land; the garbage collectors deliver to railway garbage cars, of which there are four, built at a cost of \$1,890 each. These cars deliver over the trolley line to a plant four miles out, where the garbage is drained, the water being evaporated. The solid residue goes to digester tanks for treatment with hot steam at 60 to 70 pounds pressure for six hours. It is then pressed and the grease separated, as much as 400 tons a year being obtained and sold; the remainder of the solid product is pressed into cakes for fertilizer. This Columbus plant cost the city about \$200,000 and the collection system about \$100,000. It disposes of the garbage and ashes at a total cost of about \$3 per ton.

Many of the failures, both in incineration and utilization, are due to the improper location of plants. While it should be perfectly clear to everyone that such plants should be so located as to cause the least possible property loss or inconvenience to the people, yet it should be recognized that every city must have a place for final disposal of its waste and, once properly located, it must be recognized as such. Though plants for final disposal, when properly designed and operated, have not proved a nuisance to near-by residents, nor a menace to public health, yet the assembling at one point of the material is objectionable and should be restricted to a section for such purposes. See WASTES, CITY, DISPOSAL OF.

Much has been written on the subject by both European and American engineers, principally in the form of papers read before some of the engineering societies, and published in engineering journals. Valuable information can be obtained from the files of such journals. Very little of such material, however, has been put in book form. In a small volume published in 1897, entitled 'Street Cleaning and Its Effects,' by Col. Geo. E. Waring, interesting and valuable data is assembled, a portion of which bears directly on this subject. A most comprehensive treatise on the subject is 'The Wastes of a Great City,' by John McGaw Woodbury, commissioner of street cleaning, New York, in Vol. XXIV, p. 387, *Scribner's Magazine* (1903). Consult also Venable, 'Garbage Crematories in America' (1906); Morse; 'Collection and Disposal of Municipal Waste' (1908).

GARBAGE DISPOSAL. See SANITARY ENGINEERING.

GARBER, Daniel, American painter: b. North Manchester, Ind., 11 April 1880. He made his art studies at the Cincinnati Art Academy and the Pennsylvania Academy of the Fine Arts. Since 1909 he has been a member of the faculty of the latter institution. In 1902 he was awarded the first Toppan prize at the Pennsylvania Academy; held the Cresson scholarship in 1903–05 and in 1909 won the first Hallgarten prize at the National Academy of Design. He has received numerous other rewards, medals, etc. He is represented in the permanent collections of the Chicago Art Institute, the Cincinnati Museum, the Corcoran Art Gallery, Washington, Mary Brown Memorial, Providence, R. I., the University of Missouri, the Saint Louis Museum, the Carnegie Institute, Pittsburg, and the Museum of History, Science and Art, Los Angeles. He was elected to the National Academy.

GARBORG, gär'bôrg, **Arne,** Norwegian novelist: b. island of Time, Jæderen, 25 Jan. 1851. He was educated at Christiania, published anonymously in 1873 his essay, 'Ibsen's "Emperor or Galilean," and in 1877 founded the *Fedraheimen*, a liberal journal which he edited until 1882. Characteristic of this author's way of thinking is 'The New Norwegian Language and the National Movement' (1887). His best-known work was done in his stories, originally written in the popular tongue and largely rendered into Swedish and Danish. They are of the realistic vein so common to Scandinavian writers and include 'A Freethinker' (serially in *Fedraheimen* (1878); 'Men' (1886); 'Weary Souls' (1891); 'Fred' (1893).

GARÇÃO, gär-sä'ō, **Pedro Antonio Correa,** Portuguese poet: b. Lisbon, 29 April 1724; d. there, 10 Nov. 1772. As a lyric poet he stands very high; while his satires, odes and epistles —upon the models of Horace — are dainty and spiritual. He also wrote successful dramas. The Portuguese esteem him for the perfection with which he employed their language in his works. The 'Hymn to Dido' is one of his most popular productions. He was arrested for a personal satire, and died in prison after a long captivity. He is called, by his countrymen, the "Portuguese Horace"; and his work had considerable influence on native literature, the tone of which he worked earnestly to raise. The best of the numerous editions of his works is that published by Azevedo Castro in Rome in 1888.

GARCIA, Diego, dē-ā'gō gär-sē'ä, Portuguese navigator: b. Lisbon 1471; d. Madrid 1529. In 1526 he sailed with three vessels from Cape Finisterre for South America, in the employ of the company established at La Coruña for the spice trade. He explored the Uruguay (1827), and the Paraná to 27° S., defeated the Indians who had besieged Sebastian Cabot on the latter river, and in 1528 left for Spain. About 1532 he is said to have made a voyage to the East Indies. His account of his Brazilian explorations appeared in Vol. XV of the 'Revista do instituto histórico é geográfico do Brasil.' The island of Diego Garcia is said to have been named after Garção.

GARCIA, gär-thē'ä, **Manuel,** Spanish professor of singing in England: b. Madrid, Spain, 17 March 1805; d. London, England, 1 July 1906. He invented the laryngoscope (1855) and published 'Mémoire sur la Voix Humaine' (1840) and 'Traité complet du Chant' (1847). One of his pupils was Jenny Lind. From 1850 to 1895 he was professor of singing at the Royal Academy of Music, London.

GARCÍA, Manuel del Pópolo Vicente, Spanish tenor and composer: b. Seville, Spain, 22 Jan. 1775; d. Paris, 10 June 1832. After acquiring a considerable reputation as a tenor singer at Cádiz and Madrid, in 1808 he attained great success at the Italian opera in Paris, and afterward proceeded to Italy, where he was received with equal favor. From 1816 to 1824 he was constantly engaged as a singer, either in Paris or London. In 1825, with a select operatic company, composed in part of members of his own family, he crossed the Atlantic and visited New York, South America and Mexico. On the road between Mexico and Vera Cruz he was robbed of all his money; and after his return to Paris was compelled to open a class for singing, as his voice had become greatly impaired by age and fatigue. Many of Garciá's pupils reached a high degree of excellence, but none equaled his eldest daughter Mariá, afterward Madame Malibran (q.v.). His son Manuel and another daughter, Pauline Viardot, also attained to considerable fame. He was a prolific composer of operas in Spanish, French and Italian, several of which were very popular in his day. Of his 43 compositions of this class the 'Caliph of Bagdad' is probably the best known.

GARCIA Y ÍÑIGUEZ, gär-se'ä ē ē-nyē' gās, **Calixto,** Cuban patriot: b. Holguin, Cuba, 14 Oct. 1836; d. Washington, D. C., 11 Dec. 1898. In 1868, with Donato del Mármol and Carlos Manuel Cespedes, he organized the revolution known as the "Ten Years' War." In the early part of the struggle he won the battle of Santa María and recaptured Jiguani. In recognition of his services García was appointed brigadier-general under Gómez (q.v.), and subsequently succeeded that officer as commander-in-chief of the Cuban army. In 1873 he was captured and carried as a prisoner to Spain. In 1879 he returned to Cuba to start "The Little War," but was again captured and kept in Spain under police surveillance for 15 years. In 1895 he escaped and came to New York, where he fitted out a filibustering expedition, which failed to reach Cuba on account of the wreck of the vessel. Later he was successful in landing in Cuba with arms and supplies. He was given the command of the forces in Camagüey and Oriente, where he held almost complete possession, and in 1898 gave valuable aid to the American forces at the capture of Santiago. At the close of the Spanish-American War he was made chief of the commission to discuss with President McKinley the future of Cuba.

GARCÍA MORENO, gär-sē'ä mō-rā'nō, **Gabriel,** Ecuadorean politician: b. Guayaquil, Ecuador, 1821; d. Quito, 6 Aug. 1875. He was educated at Quito and in Europe, became professor of chemistry in the University of Quito, and in 1857 its rector. In 1859, upon the overthrow of the Roble's government, he was chosen a member of the provisional government, and in 1861 President for a term of four years. He declared himself dictator in 1864 and subsequently relinquished the title and office, though he maintained virtual control of affairs. In 1869 he led a revolution, became again dictator, and in 1875 was elected President for a six-years' term. Before his inauguration he was fatally wounded by assassins. Consult Berlichingen, Adolf von, 'Gabriel García Moreno'; Cancio, A. Z. de, 'Vida de Gabriel García Moreno' (Madrid 1889).

GARCIA DE QUEVEDO, kā-vā'dō, **José Heriberto,** South American poet and dramatist: b. Coro, Venezuela, March 1819; d. Paris, June 1871. Educated in France and Spain, he settled in Paris, and was killed in the communard insurrection of 1871. Among his poems are 'To Columbus'; 'To Liberty'; 'To Pius IX'; 'Frenzy'; 'The Life to Come'; and 'The Proscript.' His dramas were well received. He wrote the novels 'The Love of a Girl' and 'Two Duels Eighteen Years Apart.'

GARCILASO DE LA VEGA, gär-thē-lä'sō dā lä vā'gä (properly GARCIAS LASO DE LA VEGA), Spanish poet: b. Toledo, 6 Feb. 1503;

d. Nice, 14 Oct. 1536. His father was councillor of state to Ferdinand and Isabel; and later Ambassador at the Court of Rome; and his mother belonged to the noble house of Guzmán. According to an account given in the 'Historia de las Guerras Civiles,' the Garcilasos received their surname from their combats with Moorish heroes, in the great valley of Granada, called *La Vega.* Garcilaso soon found his proper sphere. His genius was kindled by the study of the ancients, particularly of the Romans. Boscan had already begun to transplant the versification of the Italians into Spanish poetry. Garcilaso followed his example, and succeeded so well that he is still ranked among the best Spanish poets. Most of the events of his life may be learned from his own works. He lived for a long time in Italy, and afterward traveled through part of Germany, in the service of Charles V. In 1529 he was engaged in the expedition against Soliman, and in 1535 in that against Tunis. In the latter he received a wound in his arm, after which he remained some time in Naples. In 1536 he commanded 30 companies of infantry, and accompanied the imperial army against Marseilles. He was mortally wounded during an attack on the part of Muy and died three weeks later. Spanish poetry is highly indebted to him; for without his aid Boscan, (his bosom friend) a foreigner, would never have succeeded in his innovations, more particularly as he had a formidable adversary in Christoval de Castillejo. His writings consist of eclogues, epistles, odes, songs, sonnets (in which he imitated Petrarch) and some smaller poems. A volume of his poems first appeared at Barcelona in 1543. An edition of his works, with notes, appeared in 1765, and Herrera's commentary (1580), with notes by Azara (1765). Consult Fernández de Navarrete, E., 'Vida de Garcilaso de la Vega'; Flamini, F., 'Imitazioni italiani in Garcilaso de la Vega' (Milan 1899).

GARCILASO (GARCIAS LASO) DE LA VEGA, surnamed the INCA, Spanish historian: b. Cuzco, Peru, 1540; d. Spain, 1616. He was a son of Garcilaso de la Vega, one of the conquerors of Peru, and a member of the illustrious de la Vega family and Elizabeth Palla, a princess of the race of the Incas. His mother taught him the Peruvian language, and is said to have inspired him with the idea of writing the history of his ancestors. He went to Spain where he was well received at court and made much of, probably due to his good family connections. Later on he was imprisoned at Valladolid by order of Philip II. On his release he returned to Peru where he began his work of writing the history of ancient Peruvian civilization. His great work on the history of Peru is in two parts: the first bearing the title of 'Historia de las Antiquedades y Conquista de Piru; Primera Parte de los Comentarios Reales que tratan del Origen de los Incas, etc.' (1609); the second being the 'Historia general del Peru' (1616). He wrote also 'Historia de la Florida' (1609). His history is the greatest source of information concerning ancient Peru, its history, religion, civilization, myths, sociology and customs. It is somewhat highly colored; but the author had plenty of documentary evidence which he used in an interesting and illuminating way. Consult Markham, 'The Incas of Peru' (1910); Prescott, 'History of the Conquest of Peru.'

GARCINIA, so called after Laurent Garcin (d. 1752), a Franco-Oriental traveler, is the botanical name for a genus of the family *Guttiferæ.* It consists of opposite-leaved trees, with a yellow resinous juice, and generally unisexual flowers with four sepals, four petals, many stamens in from one to four bundles, and a 2 to 10-celled ovary with a single seed in each cell. The fruit of *G. mangostana* is the highly-prized mangosteen of the East Indies. It is about the size and shape of an orange, purple outside, divided within into segments like those of an orange. The flavor is between that of a grape and a peach. The friuts of *G. pedunculata, G. cornea* and *G. kydiana* are also eaten, but are not greatly valued. *G. kola* of tropical Africa yields fruit and seeds similar in properties to the kola-nut. *G. cambogia* and other species of the genus furnish Gamboge (q.v.).

GARDA (gär'dä) or **BENACO LAKE,** the Italian *Lago di Garda,* and the *Benacus Lacus* of the Romans, is an extensive and beautiful lake in North Italy, 33 miles long from north to south, by 3 to 11 miles broad, and 213 feet above sea-level. It forms part of the boundaries of the provinces of Verona, Mantua and Brescia, while its north extremity enters the Austrian territory of Trent, in the Tyrol. It receives the Sarca, almost its only affluent, at its north end, and is drained by the Mincio, which issues from its southeast end near the fortress of Peschiera, and conveys its waters to the Po. Storms are not infrequent, and are sometimes violent. It is well stocked with excellent fish, including salmon-trout, trout, eels and pike. Garda is the largest lake in Italy, and attains a depth of over 1,000 feet in many places. Its shores are covered with villas, and steamboats ply on it regularly between the ports of Riva, Desenzano and Peschiera, which with Gardone-Riviera, Garda, Malcesine Salo and the beautiful promontory of Sirmione are its most popular resorts.

GARDE, Thomas William, Danish explorer: b. 1859. He made several tours of exploration in southeast Greenland, starting from Cape Farewell. He discovered Norse remains at Lindenows Fjord, over 200 live glaciers, very many over a mile wide between Nanortalik and Cape Farewell. In 1893 he explored the Greenland ice cap, which he found to exceed 8,000 feet in height at certain places. He received the commission of commander in the Danish navy; subsequently was appointed to the chief of staff, and in 1908–11 was made assistant to the Minister of the Navy. The story of his explorations is contained in 'Meddelelser om Gronland' (Vols. IX and XVI).

GARDE NATIONALE, gärd nä-sē-o-näl, a guard of armed citizens instituted in Paris 13 July 1789 for the purpose of preserving order and protecting liberty. At first it numbered 48,000 men, but was increased to 300,000 when it was organized throughout the whole country. Acting as a royalist and reactionary force, it was crushed by Napoleon in 1795. It was reorganized by the Directory and by Napoleon and again under the Bourbons, to whom, however, it was a source of such disquietude that it was dissolved by a royal ordinance in 1827. Under Louis Philippe it was resuscitated in its old form and contributed to his overthrow. In 1851 the national guard was again reorganized, but in 1855 it was dissolved. In 1870 the national guard of Paris was again formed for the defense of the city against the Prussians. The resistance of a section of the guard to the decree of disarmament issued under M. Thiers led to the Communal War, at the close of which the guard was declared dissolved by the National Assembly (1871).

GARDEN, Alexander, Scottish scientist: b. Charleston, S. C., about 1730; d. London, 15 April 1791. He was graduated from Aberdeen; became a professor in King's College, New York (now Columbia University), and in 1755 established himself in medical practice at Charleston. From 1783 he was in London, where he became vice-president of the Royal Society. The botanical genus *Gardenia* (q.v.) was named in his honor by Linnæus.

GARDEN, Alexander, American soldier: b. Charleston, S. C., 4 Dec. 1757; d. there, 29 Feb. 1829. He was for a time aide-de-camp to General Greene. He wrote 'Anecdotes of the Revolutionary War in America, with Sketches of Character of Persons the most distinguished in the Southern States for Civil and Military Services' (1st series, Charleston, 1822; followed by a second series), which is one of the authorities for the history of the period, containing information hardly to be found elsewhere.

GARDEN. The earliest known gardens are those of Solomon, which are described as having been of quadrangular form, surrounded by high walls. They contained aviaries, wells and streams of water. The gardens of Cyrus and other Persian monarchs were of great extent, and generally laid out in romantic situations. They were also distinguished for the great diversity of their uses and products. The first allusion to terraces in gardens is to be found in the description of the celebrated hanging gardens of Babylon, anciently reckoned among the wonders of the world. Their construction is variously ascribed to Queen Semiramis and to Nebuchadnezzar. Diodorus and Strabo have given descriptions of them. They are said to have formed a square with an area of nearly four acres, and rose in terraces, supported on masonry arches, to a height of 75 feet. They were irrigated from a reservoir built at the top, to which water was lifted from the Euphrates by a screw. Fountains and banqueting-rooms were distributed throughout the numerous terraces; groves and avenues of trees, as well as parterres of flowers, diversified the scene; while the view of the city and neighborhood was extensive and magnificent. Most of the elements of a modern architectural garden are alluded to in connection with those of Babylon. The grove of Orontes, described by Strabo, must be regarded as a park or large garden in the picturesque style; it was nine miles in circumference.

In ancient Greece, gardening was rather a neglected art at first, but in process of time great advance was made. The vale of Tempé, the Academus at Athens, and other public gardens were extremely elegant and were ornamented with temples, altars, tombs, statues, monuments and towers. The Greeks copied their gardening from the Persians; and the Romans, in their turn, copied that of the Greeks. Little is known of the early style of Roman gardening; the vast edifices projecting into the sea, and the immense artificial elevations, are apparently ridiculed by Cicero and Varro. About this time, however, began the cultivation of odoriferous trees and plants; and the planting of trees adjoining each other, whose odors assimilated, was then as much a study with the gardener as the harmonious blending of colors at the present day.

The early French and Dutch gardens were evidently adopted from the description of Pliny's garden. The use of glass in the construction of conservatories was early known to the Greeks and Romans; and the "Gardens of Adonis," mentioned by some of their most eminent authors, were probably of this kind. Gardening, like all the other arts, languished during the Dark Ages, but with the revival of learning, the invention of printing, and the Reformation, it began again to flourish. The art was revived and patronized by the family of the Medici in Italy; and their gardens, which were of the geometric and architectural style, long served as models for most of Europe. They continued to be imitated in France, Germany and Great Britain till the introduction of the English or natural style. In garden architecture very little progress, as far as hothouses are concerned, has been made in southern Europe, the warmth of the climate rendering them all but useless. There are, however, plant houses in many places in Spain and Portugal. The French and Dutch gardens resemble each other closely; symmetry and profuse ornament are the characteristics of both. The Dutch style is eminently adapted to the nature of the country, where there are no inequalities of surface, as in England. The French style seems to have arisen about the middle of the 17th century, during the reign of Louis XIV. The most celebrated gardener of the period was Le Nôtre, who laid out the famous gardens of Versailles. Le Nôtre's style spread rapidly into other countries. The first erection of hothouses in France took place toward the end of the reign of Louis XIV by M. Fagon, in the Jardin des Plantes. The first magnificent attempt at hothouse building was that of Francis I, of Austria, in 1753. They were in five ranges, extending altogether to the length of 1,290 feet, many of them being 30 feet high. From about 1760 landscape gardening, and the adoption of the English style, rapidly spread into France, Germany and Russia, where it still prevails. See CITY PLANNING; FLOATING ISLAND; FLORICULTURE; FLOWERS; GARDEN CITIES; GREENHOUSE; HORTICULTURE; CROSS-FERTILIZATION; PLANT BREEDING, ETC.

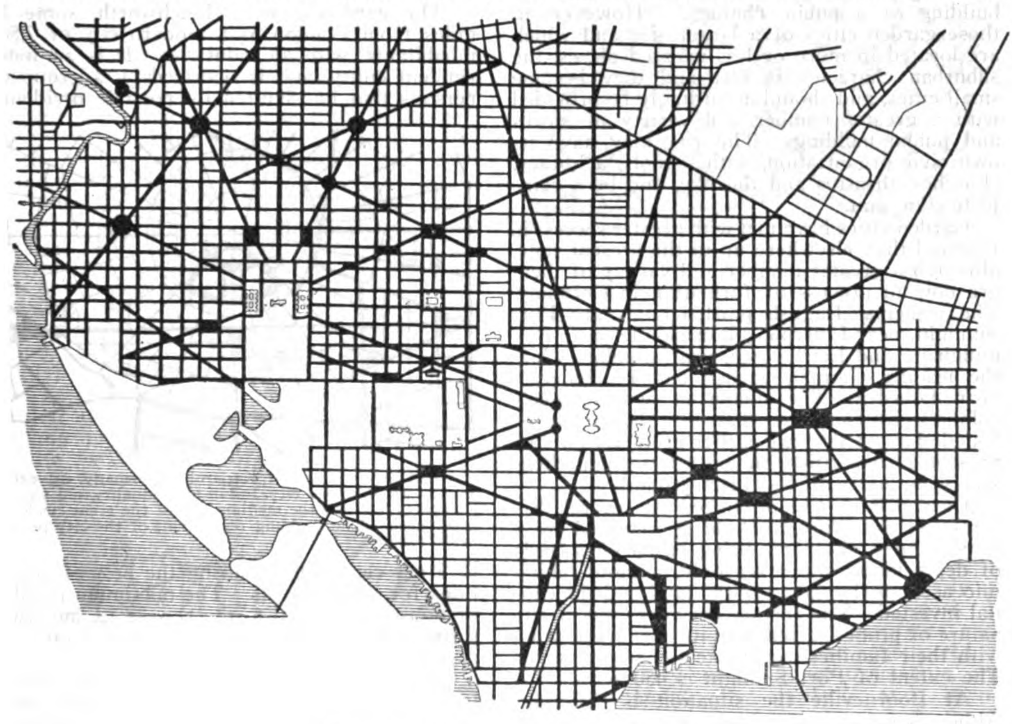
GARDEN CITIES. The disassociation of the idea of home life with modern existence in the metropolitan centres is a matter of serious concern to the social economist. In the body politic the city is merely a commercial organ, a convenience in the nation's commerce, a clearing-house for domestic and inter-nation commodities — in a word, an artificial juxtaposition of elements depending for their life or entertainment upon the power of capital or social standing. To those of wealth, or to the transient within its gates, metropolitan life is an ideal existence, offering advantages of social life, human interest, art, literature and the thousand and one things that day and night bring forth. On the other hand, the salaried man or the wage earner, forced to live in inadequate, and oftentimes unsanitary, quarters, lacking in opportunity for recreation, leads a most undesirable existence, tempered alone by the "hope eternal" that springs up in every human breast.

Is it a wonder then that men and women and children dream of the green fields and running brooks, and of the day when they may have their own home — a real hearthstone — in the country, where Nature in gladsome abundance welcomes all mankind as her children? Indeed, many do break the shackles of city life for rural retreats, but the vast majority dream on, existing from pay day to pay day, with the same old "hope eternal" burning in their breasts, but with constantly diminishing flame.

It is not possible for everyone to live in the country, but it *is* within the ability of many that are now housed in cramped quarters in the city to own their own homes and live and rear their families in the free country life — cheaper, more healthful and with a maximum of personal comfort and individual standing.

Among the plans that have been carried out abroad and in the United States to a rapidly increasing extent are those of garden cities, workingmen's colonies and suburban gardening. Of these the garden city in its best form is a well-organized development, in which from 100 to 500 homes make up a unit, which is intended to become little if any larger. When additional demands spring up for quarters, a new garden city is formed elsewhere, and thus the identity of the existing one is preserved indefinitely, and the residents, in the expectation of spending their whole lives in their own homes, have every incentive to improve and embellish them, and keep their grounds in the best possible condition.

The garden city in plan should be laid out in the simplest, yet in the most attractive, manner. There being little traffic of consequence, the streets should be laid out with that degree of irregularity that ensures charm. Some of the streets should be winding, while the straight ones should have suitable terminals. Each house should be provided with a spacious garden, as it is from such gardens that these cities derive their name. These gardens, though partially devoted to vegetable raising, should also be well laid out with flower beds, and the whole garden city should be subject to such regulations as will ensure sufficient attention to this feature to produce the intended appearance. Grass plots, trees, hedges, shrubbery and arbors should be provided in abundance, both in the front and in the rear of the houses. The neglect of the residents should not be allowed to mar the appearance of the city.



Great ground plan of Washington, D. C.

As to the houses, they may be quite simple and compact in design, but they should all be individual in character, and by no means the frightful rows of boxes all exactly alike that are put up for workingmen's use in the usual rural or suburban places devoted to such purposes. The economical design of the buildings and the small expenses for streets make the housing cost small, so that the rents may be low, or the workingman may, within a reasonable length of time, become the owner of his own home.

Garden cities should be laid out within easy reach of transit facilities and natural advantages of site should be availed of whenever possible, to give individuality and charm to the plan.

The sanitary arrangements of garden cities should be carefully planned and carried out, and the details should be simple and at the same time the construction should be solid and as inexpensive as possible.

A garden city is principally a place of residence and it should have as few stores as possible, only those of the most necessary character being provided. A school may be the only building of a public character. However, in those garden cities of a larger size and which are located in more or less isolated places, the suburban character is lost and they become small cities, and should accordingly be provided with a greater number and variety of stores and public buildings. The city may have its own civic organization, with schools, a library, churches, theatres and the like, and be a complete civic unit.

Garden cities have met with greater success in England than elsewhere up to the present time, although a greater number and variety of them are now in process of formation in Germany. The principal English garden cities are Port Sunlight, near Liverpool, Bourneville, near Birmingham, and Letchworth, near London, while the leading German garden city is Hellerau, near Dresden. The numerous workingmen's colonies in Germany that first began to be founded about 1863 are earlier prototypes of the present garden cities, but on a less comprehensive scale and with less open ground.

Garden cities are organized on several different plans. Port Sunlight is operated by a soap factory, the rents being based on a basis of depreciation and taxes only, without taking into account the value of the land and the capital invested. The factory considers this in the nature of profit sharing with its employees, who, with their families, constitute the sole tenancy. The extent of Port Sunlight is 450 acres.

At Bourneville the situation is different. Although half of the tenants are employees of the concern under whose patronage the city is operated, any one is eligible to become a resident. The rents are higher but the city is an individual entity administered by an independent corporation. There are some 5,000 inhabitants in Bourneville, occupying 925 houses. The city covers 612 acres of land, and one-tenth of the land, in addition to that occupied by roads and gardens, is reserved for parks and recreation grounds. In no case is the building allowed to cover more than one-fourth of the plot belonging to it, and the number of houses is usually from 7 to 10 per acre.

The large amount of ground left open permits of vegetable gardens, the produce of which materially reduces the cost of living of the householders. Under ordinary conditions land yields a return of about $25 per acre, but that portion utilized in Bourneville for raising produce returns a valuation of some $150 per acre, in addition to housing an average of 30 persons per acre in the occupied portions of the city.

Hellerau, which is about three miles from Dresden and covers 325 acres, has a population of about 1,000, and the land is held by a corporation which limits its dividends to 4 per cent. The village is occupied by the employees of a single concern, the *Deutsche Werkstäten für Handwerkkunst*, the chief owner of which — Karl Schmidt — is the leading spirit of the Hellerau improvement. The building is largely carried on by the Co-operative Building Association of Hellerau, which secures its capital at low rates from the governmental insurance funds. These enormous funds are thus utilized in a twofold manner — the principal for improving housing conditions and the income for the amelioration of the beneficiaries.

The garden city of Letchworth, some 35 miles from London, is a modern city of 7,500 inhabitants, with 49 industries. It is an independent entity, and is operated by a group of persons that has limited its possible dividends

Great ground plan of Karlsruhe, Germany, an exceptionally well-planned city, full of individuality and variety. The portion above the medium line of the great circle is a forest park. The building regulations of the city provide for 16 zones.

to 5 per cent, thus ensuring the best of conditions for the residents. The maximum number of houses permitted to the acre is 12, and two-thirds of the six square miles of the city are reserved for parks and similar uses.

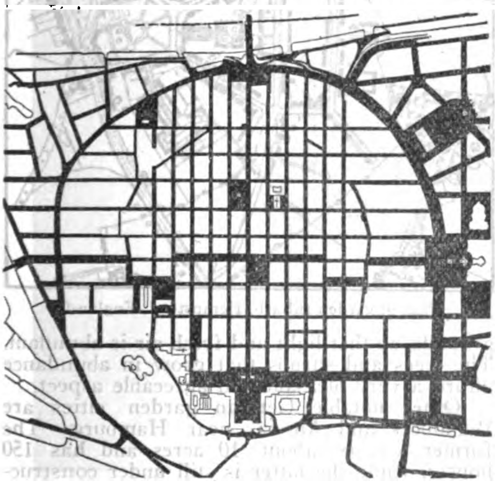
Another interesting example will be found in Forest Hills Gardens, Long Island, New York, a town-planning enterprise in which certain trust funds have been invested and which is conducted wholly on commercial lines in the expectation that a fair profit will be earned from the investment. As a real estate proposition it may not differ much from other first-class Long Island developments. It is not a garden city for workingmen, however, but is intended for persons of ampler means.

The main points in the general layout or great ground plan are the direct, ample, convenient thoroughfares, the gently curved residence streets, so laid out as to allow for deep front gardens; the interior parks for the private use of the residents, and the large amount of land in proportion to the size of the development that is put aside for common use. Each block is considered as a unit and treated as such. This separate block planning gives a beauty and variety not possible with the ordinary rectangular block plan.

Unity of design is the special attraction of the gardens, and this unity has been faithfully adhered to. The station, the inn, the stores, the apartments, and the houses, large and small, while varying in treatment and material, are all harmonious in design. The whole place has an atmosphere that is homelike, refreshing and distinguished with a real individuality. Like all other high-class suburban developments, the individual or free standing house will predominate, but an attractive feature of the building plan is the so-called "Group-Building." This plan makes it possible to buy a house of superior construction and enduring value at a lower price, for the reason that the land may be used more economically when the houses are either semi-detached or one of a group of three, four, six, eight or 10 houses set contiguously in a row. These groups and rows add greatly to the charm and variety of the building scheme. They have been planned so as to conform to the land and road contours, and are of different sizes and prices, with varying interior arrangement and architectural treatment. There is no subject upon which the developers of the gardens have laid more stress than upon the value of the common use of land as a factor in community life.

When the plans of this company were first officially made public, disappointment was expressed that the enterprise would not benefit the mechanic or day laborer, such as the English development at Port Sunlight. This, however, was impracticable owing to the location of the property, the initial cost of which would only permit the upbuilding of a high grade residential suburb.

These examples indicate the scope of the garden city idea in its various applications, from the housing of the employees of a single factory to the establishment of an independent and thriving city.



Great ground plan of Mannheim, Germany, a plan which with its outer horseshoe has proven highly satisfactory. It offers a solution of street replanning for American cities with their gridirons and has been followed in the proposed plans of Chicago and other cities.

The workingmen's colonies were the prototypes of the garden cities and had their origin in the workingmen's quarters established by the Krupp Company at Essen, beginning in 1855, with barracks affording lodging and board for 200 men to start with, continuing with the erection in 1863 of a colony of 160 dwellings at "Alt West End," the first actual colony continuing with various additions to the present time until, with the colonies of Westend, Nordhof, Baum-

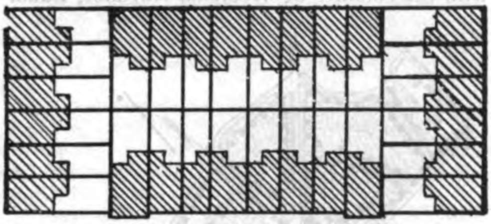
Plan of garden suburb, Dalhauser Heide, near Essen, Germany.

hof, Schederhof, Cronenberg, Alfredshof, Friedrichshof, Magarethenhof, Dalhauser Heide, Emscher Lippe and Colony Gaarden and the miscellaneous quarters in Essen, the Krupp works house 12,800 men and their families, a total of 46,000 persons.

The colony Cronenberg, the largest and best known, was mainly erected during the years from 1872 to 1874. The buildings are partly set up in rows of three-storied houses containing 30 to 40 dwellings in each block, and partly of three-storied semi-detached houses with 12 dwellings, six of them accessible from each gable front. The buildings are constructed of brick or quarry-stone without ornaments, and are surrounded by gardens and lawns. Throughout, each staircase gives access to six dwellings, to two each on each floor from a small landing, through a private front door. The streets are lined with trees, and in the midst of the colony there is a spacious park, which in connection with the gardens surrounding the houses gives to the whole a most agreeable aspect. Subsequent to 1891, 204 additional dwellings were erected, so that the entire colony now contains 1,454 workingmen's dwellings of from two to three rooms, and some of as many as six rooms.

From 1894 to 1899 the principal portions of Alfredshof and Friedrichshof were erected, and in the construction of these colonies æsthetic as well as practical and sanitary considerations were emphasized. The plans on which the streets were laid out, the varying positions of the buildings as regards the streets, the provision for spacious open grounds, the application of a handsome and varied architecture and the utilization of bright colorings in the roofs and façades lend to these colonies a most attractive aspect.

In fixing the ground plans of the several dwellings allowance was made for the high



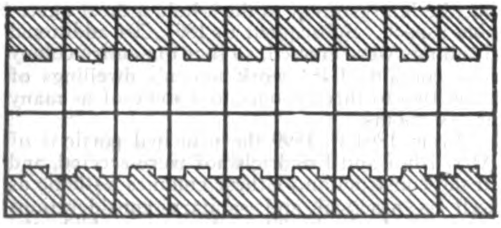
Type of half open block system found in England, Holland and Germany.

standard of the workingman's life at present, and accommodations of two rooms, therefore, were altogether abandoned, and sets of three or more rooms only were admitted. Each one-family cottage was given a small garden and houses of two or more stories were provided with verandas and loggias, to afford their occupants a sitting place in the open air. Each kitchen was also provided with a larder.

The first lot of houses in Alfredshof was erected on the cottage system, in one, two, three and four family cottages, in rows, each containing a small number of houses. To each family-lodging a small garden is attached. The dwellings in the semi-detached or double semi-detached cottages are also completely separated, each family having its own private entrance through its own garden. At the entrance of each dwelling is a veranda.

In 1899 construction work in Alfredshof came temporarily to an end. When it was resumed in 1907, the ground had in the meantime become so dear that it was deemed inadvisable to continue the system. Therefore, in order to utilize the building space more rationally, and in order to provide a sufficient number of dwellings in the neighborhood of the works, corresponding to the increased number of workingmen, a more compact mode of building had to be adopted.

The question could only be solved by the multiple-storied house arranged in flats, which at the same time afforded the possibility of harmonizing the colony architecturally with the town houses in the vicinity. The houses were arranged in blocks, an arrangement already adopted in the Friedrichshof. By an artistic grouping of the blocks, by leaving sufficient open ground, lawns and playgrounds between,



Block with open ends as found in Mannheim and Posen.

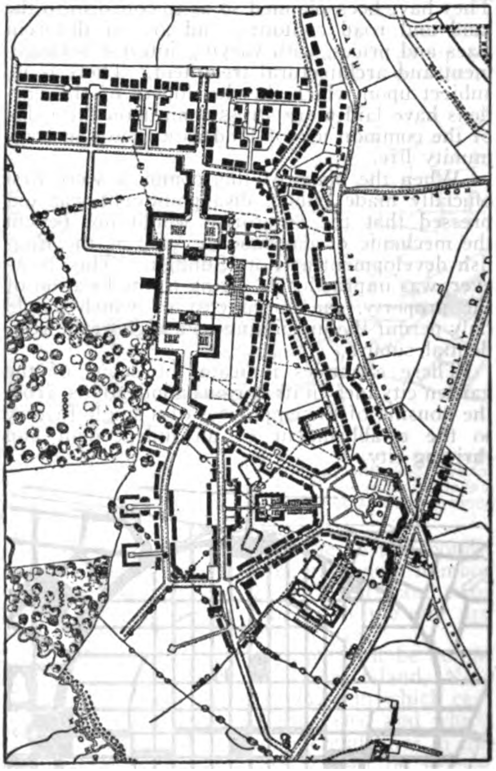
and by carefully preserving existing trees, this new part of Alfredshof was made to answer all modern requirements as regards healthfulness and beauty.

The annual rents in these colonies are:

	In One-Family House	In Multiple-Family House
Three-room dwelling	$47.50 to $55.00	$42.50 to $52.50
Four-room "	62.50	55.00 " 60.00
Five-room "	75.00 " 96.00	65.00 " 70.00

In opposition to the Altenhof and the older part of the Alfredshof, this colony was from the very beginning erected on the system of the two or more storied house on account of the valuable and rather limited building space. Six or four families enter the residence from one common entrance, and two or three families have one laundry in common. But apart from the street door each dwelling has its own private front door on the landing.

The three or two storied houses of this colony are united into more or less large blocks, which are grouped around squares and play-



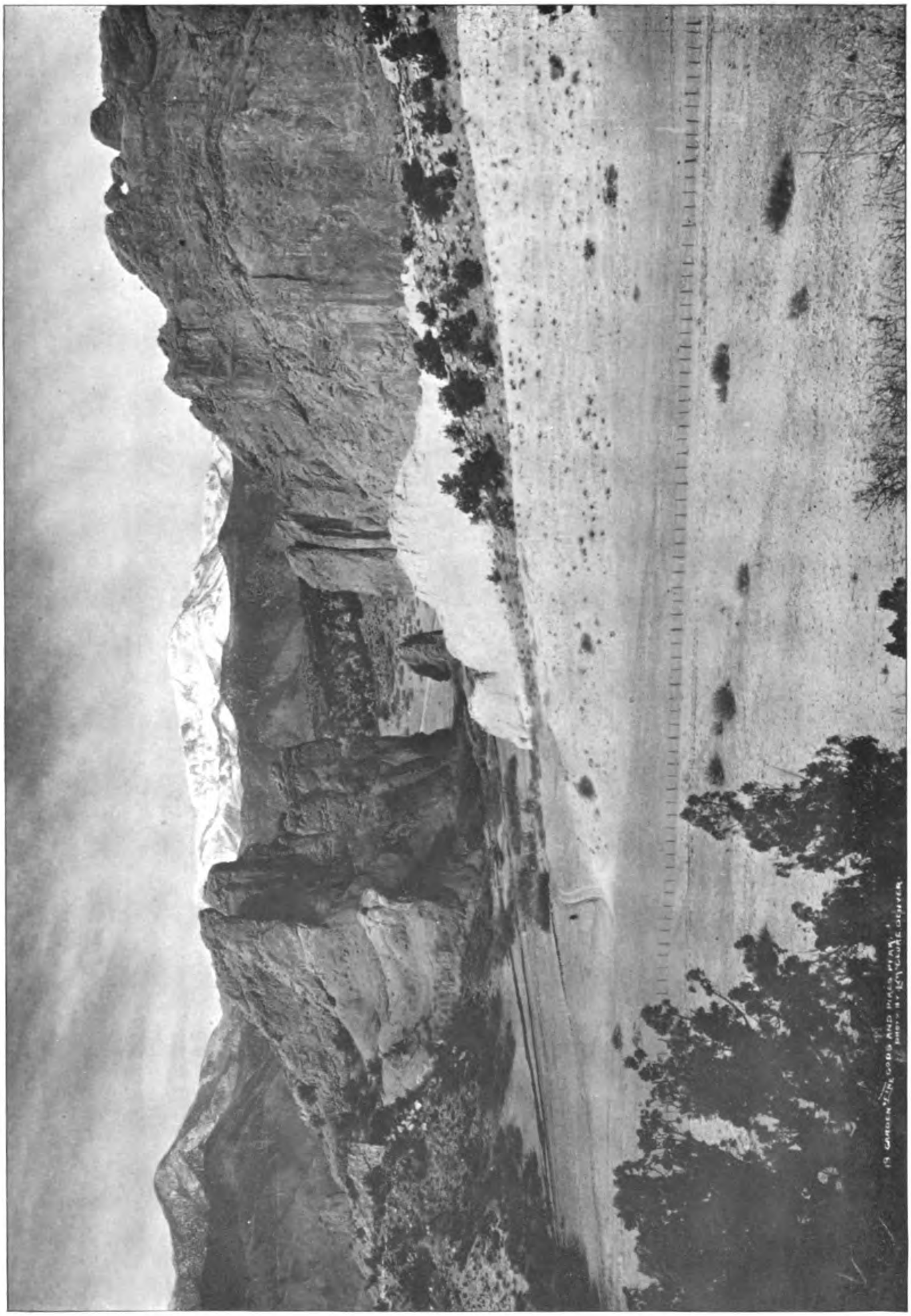
Plan of garden suburb, Hempstead, England.

grounds, so that light and fresh air is abundant. The trees and shrubs that grow in abundance afford a very pleasant and agreeable aspect.

Other notable German garden cities are Wandbeck and Altona, near Hamburg. The former covers about 10 acres and has 150 houses, while the latter is still under construction, with municipal assistance. It will ultimately provide for a population of 30,000 persons. In addition a large number of co-operative associations have been formed in Germany at Rostock, Plauen, Tilsit, Bonn, Chemnitz, Aachen, Halle, Dortmund, Erfurt, etc., and a considerable number of garden cities have been under construction or completed.

Industrial home towns is the usual term in the United States for what the British call

GARDEN OF THE GODS



Gateway to the Garden of the Gods, near Manitou, on the Denver and Rio Grande Railroad, Pike's Peak in the distance

garden cities, and the Germans, «Workingman's colonies.» The basic principles are practically the same, the exception being that in British practice there are fewer houses per acre — that is, more ground is allotted to gardens, lawns, parks, playgrounds and streets. The Hempstead suburban garden has eight one-family houses per acre, exclusive of streets; Hempstead tenants, 10; Ilford, eight; Letchworth Garden City, 12 one-family houses per net acre. American industrial home towns have as many as 18, and even more, houses per net acre.

Notable among the industrial house towns of the United States are those of the Goodyear Heights Realty Company, Akron, Ohio; Kenosha Home Association, Kenosha, Wis.; Delaware and Lackawanna Railroad Company, Kistler, Pa.; the Improved Housing Association, New Haven, Conn.; aside from those mentioned, there are numerous other industrial home town developments now under way in various parts of the country.

FRANK KOESTER,
Author of 'Modern City Planning and Maintenance.'

GARDEN CITY, N. Y., a village on Long Island in Nassau County, on the Long Island Railroad, 20 miles east of New York. It was founded by Alexander T. Stewart as a residential town. It is the seat of the Protestant Episcopal bishop of Long Island, and contains the cathedral of the Incarnation. Here are also the cathedral schools, Saint Mary's and Saint Paul's, and the factory of a large publishing house. Pop. about 1,000

GARDEN OF THE GODS, a small region in Colorado, near Colorado Springs, in which are seen some of the most striking effects of erosion ever found upon the globe. The «Garden» covers an area of about 500 acres, within which are sandstone rocks, red and white, in forms of grotesque magnificence — columns, «cathedral spires» and giant figures sometimes appearing almost as if made in human likeness. To many of these shapes have been given distinctive names suggested by their various formations. The road into the «Garden» enters through the huge «Gateway» of red rock-masses 330 feet in height.

GARDEN SNAIL. See SNAIL.

GARDEN VILLAGES. See VILLAGE.

GARDEN WEBWORM. See WEBWORM.

GARDENER, Helen Hamilton. See SMART, HELEN HAMILTON.

GARDENER BIRD. See BOWER-BIRDS.

GARDENIA, a genus of shrubs or small trees of the family *Rubiaceæ,* containing about 60 species in the subtropical regions of the Old World. They have mostly glossy, entire leaves and showy, solitary or clustered, yellow or white flowers. *G. Jasminoides,* the Cape jasmine, is a shrub with waxy double flowers, much cultivated for hedges from Virginia southward. It was formerly popular as a greenhouse plant but is little grown now.

GARDENING, Landscape. See LANDSCAPE ARCHITECTURE.

GARDINER, gärd'nėr, **Asa Bird,** American lawyer: b. New York, 30 Sept. 1839. He was educated at the College of the City of New York and New York University; during service in the Civil War attained the rank of captain and received a medal of honor for bravery; was professor of law in the United States Military Academy in 1874–78, and became district attorney of the county of New York in 1897. He held important posts in the Society of the Cincinnati and other organizations. Author of 'The Writ of Habeas Corpus as affecting the Army and Navy' (1874); 'The Order of the Cincinnati in France' (1905), etc.

GARDINER, Frederic, American Protestant Episcopal clergyman: b. Gardiner, Me., 11 Sept. 1822; d. Middletown, Conn., 17 July 1889. He was graduated from Bowdoin College in 1842, from the General Theological Seminary, New York, in 1845; was rector of Trinity, Saco, Me., 1845–47; rector of churches at Bath (1848–53) and Lewiston, Me., (1855–56); and in 1865 became professor of the literature and interpretation of Scripture in the Gambier (Ohio) Theological Seminary. In 1867 he was appointed professor of the Old Testament language and literature in Berkeley Divinity School (Middletown, Conn.), and in 1883 of New Testament interpretation and literature in that institution. He founded (1880) the Society of Biblical Literature and Exegesis, and published 'The Island of Life' (1851); 'Diatessaron' (1871); 'The Old and New Testaments in their Mutual Relations' (1885).

GARDINER, Harry Norman, American educator: b. Norwich, England, 6 Nov. 1855. In 1874 he came to the United States; was graduated at Amherst in 1878, and subsequently studied at Union Theological Seminary (1879–82), Göttingen, Leipzig and Heidelberg. In 1878–79 he taught in the Academy of Glens Falls, N. Y.; in 1891–92 was instructor in psychology in Amherst; was instructor (1884–88) and subsequently professor of philosophy at Smith College after 1888. He is member of the American Psychological Association, the American Philosophical Association (president 1907) and of the American Association for the Advancement of Science. He has published 'Outlines of Modern Philosophy' (1892) and edited 'Jonathan Edwards — A Retrospect' (1901) and 'Selected Sermons of Jonathan Edwards' (1904).

GARDINER, John, American lawyer: b. Boston, 1731; drowned off Cape Ann, 15 Oct. 1793. He was a son of Sylvester Gardiner (q.v.). He studied law at the Inner Temple, London, and was admitted to practice at Westminster Hall. He formed an intimacy with Churchill and Wilkes, and was junior counsel of the latter at his trial in 1764, and also appeared for Beardmore and Meredith, who for writings in support of Wilkes had been imprisoned on a general warrant. In 1766 he procured the appointment of attorney-general in the island of Saint Christopher, where he remained until after the American Revolution, when he returned to Boston. After residing there a few years, he removed to Pownalborough, Me., which place he represented in the Massachusetts legislature until his death. As a legislator he distinguished himself by his efforts in favor of law reform, particularly the abolition of special pleading, and the repeal of the statutes against theatrical entertainments. In connection with the latter subject he published a 'Dissertation on the Ancient Poetry of the Romans,' and an accompanying speech. The abolition of the law of primogeniture in Massachusetts was due to his efforts. He was one of the most influential of the early Unitarians of Boston, and participated in the change of King's Chapel from an Episcopal into a Unitarian Congregational church.

GARDINER, John Sylvester, American Episcopal clergyman: b. Haverford West, South Wales, England, June 1775; d. Harrowgate, England, 29 July 1830. He was a son of John Gardiner (1731–93) (q.v.); accompanied his father to the West Indies, and subsequently studied in Boston, and in England under the celebrated Dr. Parr. Returning to America, he became a candidate for orders in the Protestant Episcopal Church, and in 1797 was ordained. In 1805 he became rector of Trinity Church, the chief Episcopal parish in Boston, with which he remained connected until his death. He was an accomplished scholar and a forcible preacher. In the establishment of the *Boston Anthology and Monthly Repository*, for which he was a frequent writer, he contributed materially to the dissemination of literary taste and culture in Boston. He was also one of the founders of the Boston *Athenæum*. He wrote the 'Jacobiniad,' a satire in prose and verse directed against the liberal clubs of Boston to which, being in politics a strong Federalist, he had an antipathy.

GARDINER, Lion, English settler in America: b. 1599; d. 1663. After service in the English army, he came to America in 1635 as the representative of a land company which had a patent of territory at the mouth of the Connecticut. He built a fort to which he gave the name of Saybrook, compounded from the names of Lord Say and Sele and Lord Brook, two of the patentees, and remained in charge until 1639. He made on an island, called by him the Isle of Wight (now Gardiner's Island, township of Easthampton), the first English settlement within the limits of what is now the State of New York, and there he lived in baronial style.

GARDINER, Samuel Rawson, English historian: b. Ropley, Hampshire, 4 March 1829; d. Sevenoaks, Kent, 23 Feb. 1902. He was educated at Christ Church, Oxford, studied also at Edinburgh and Göttingen; was professor of history at King's College, London, in 1877–85, historical lecturer for the University Extension Society in 1880–94, and examiner in the Oxford final history school in 1886–89. He was elected to a research fellowship by All Souls, Oxford, in 1882, and to a similar fellowship by Merton, in 1894. On Froude's death (1894) he declined appointment to the Oxford regius professorship of modern history. It is for his work of research in the history of England from 1603 to 1660 that he is best known. The results were published in instalments later assembled in various collective editions. In the course of his investigations he examined the minutest details with extraordinary care. He inspected the scene of most battles which he described; he thoroughly familiarized himself with the state papers of the Record Office; and for the study of the state papers foreign and the contents of other national archives learned six continental languages. No source of information was left unexhausted. It is stated that he was the only one that ever read the entire collection of Thomasson tracts in the British Museum. Though himself a Liberal in politics, his writing was wholly judicial and impartial. Perhaps no other English historian ever labored more enthusiastically for historical truth and no one was more judicious in his treatment of sources. His style is clear and well-ordered, and in later volumes vigorous and often impressive. He was the first to describe in full the period of Commonwealth and Protectorate from an unprejudiced viewpoint, and he was also the first to explain satisfactorily the beginnings of the Cavalier party and the rise of the civil war. He was fortunately enabled to utilize many newly discovered sources. His work was not at first popular, but its worth was later fully recognized. In 1882 he received a civil-list pension of £150. The titles of the larger divisions of his great undertaking are 'History of England from the Accession of James I to the Disgrace of Chief Justice Coke' (1863); 'History of England from the Accession of James I to the Outbreak of the Great Civil War' (1883–84); 'History of the Great Civil War' (1886–91); and 'History of the Commonwealth and Protectorate' (1894–1901), in three volumes, a fourth to be completed by Firth. He wrote also 'Cromwell's Place in History' (1897); 'Oliver Cromwell' (1899); and other works, including 'The Thirty-Years' War' (1874); 'The First Two Stuarts, and the Puritan Revolution' (1876); 'Introduction to the Study of English History' (with Mullinger, 1881); 'Constitutional Documents of the Puritan Revolution' (1889); 'Student's History of England' (1890–92); 'School Atlas of English History' (1891); 'What the Gunpowder Plot Was' (1897).

GARDINER, Sylvester, American physician: b. Kingston, R. I., 1717; d. Newport, R. I., 8 Aug. 1786. He studied medicine in London and Paris, subsequently practised his profession in Boston, and opened there a drug establishment, from which the New England colonies were chiefly supplied. He was one of the early promoters of inoculation for the smallpox, and a liberal contributor for the erection of King's Chapel, Boston. He became possessed of large tracts of land in Kennebec County, Me., and about the middle of the century was instrumental in establishing there the settlement of Pittston, a portion of which was subsequently set off into a separate town, under the name of Gardiner, where he built and endowed Christ Church. He retired from Boston on its evacuation by the British troops, but returned to the United States at the close of the Revolutionary War, and passed the rest of his life there.

GARDINER, Me., a city in Kennebec County, on the Kennebec River, and on the Maine Central Railroad, six miles from Augusta. Separated from Pittston and incorporated as a town in 1803, it was chartered as a city in 1848. It has admirable water power, valuable manufacturing interests, and an assessed property valuation of more than $4,000,000. The ice-cutting industry employs 1,000 people, with an annual output valued at $75,000.

The commission form of government was adopted by the city, and became operative in 1912. Pop. 5,311.

GARDINER'S ISLAND, N. Y., an island in a bay of the same name at the northeastern extremity of Long Island. It is part of the township of East Hampton, Suffolk County, and has an area of 3,300 acres, mostly undulating pasture land. It was bought from the Indians by Lion Gardiner in 1639. Captain Kidd (q.v.) buried part of his treasures on the island in 1699, but they were recovered in the same year by the colonial authorities.

GARDNER, Augustus Peabody, American congressman and soldier: b. Hamilton, Mass., 5 Nov. 1865; d. Camp Wheeler, Va., 16 Jan. 1918. He was graduated at Harvard in 1886; was a member of the Massachusetts State senate (1899–1901), and was elected to nine congresses, from the 57th to 65th inclusive. During the Spanish-American War, he served as captain and assistant adjutant-general on staff of Gen. J. Wilson In 1913 he was Republican nominee for governor of Massachusetts. An earnest advocate of American participation in the European War, he entered the army in 1917 as colonel in the Officers Reserve Corps. He procured demotion to major, so that he might see active service sooner. He died while in training at Camp Wheeler, and was interred at the national capital.

GARDNER, Edmund Garratt, English scholar in Italian: b. London, 12 May 1869. He was educated at Gonville and Caius College, Cambridge. Intended for the medical profession, he soon abandoned it for the study of Italian literature and history, especially the study of Dante. He has devoted much time to research in Italian archives and libraries, and, more recently, to the investigation of mysticism and kindred subjects. He is Barlow lecturer on Dante at University College, London. His publications include 'Dante's Ten Heavens' (1898); 'A Dante Primer' (1900); 'The Story of Florence' (1900); 'Desiderio' (1902); 'The Story of Siena and San Gimignano' (1902); 'Dukes and Poets in Ferrara' (1904); 'The King of Court Poets' (1906); 'Saint Catherine of Siena' (1907); 'The Cell of Self-knowledge' (1910); 'Dante and the Mystics' (1914); 'The Book of Saint Bernard on the Love of God' (1916).

GARDNER, Ernest Arthur, English archæologist: b. London 1862. He was educated at Cambridge University, and was director of the British School of Archæology at Athens, 1887–95. From 1884 he has been engaged in archæological researches in Egypt, Athens, Paphos in Cyprus, Megalopolis and elsewhere, and has lectured and written much upon Greek art and archæology.

GARDNER, Eugene C., American architect; b. Ashfield, Mass., 28 March 1836; d. Springfield, Mass., 7 Feb. 1915. He was principal of the academy at Tallmadge, Ohio, 1852–62. He then removed to Northampton, Mass., where he resided 1863–68, engaged in architectural work, going to Springfield, Mass., in the latter year, editing *The Builder* 1885–87, and writing for the *Springfield Republican*. In 1901 he was elected a member of the Massachusetts House of Representatives. Among his works are 'Homes and How to Make Them'; 'Illustrated Homes'; 'Home Interiors'; 'The House that Jill Built'; 'Town and Country School Houses'; and 'Common Sense in Church Building.'

GARDNER, Henry Brayton, American educator: b. Providence, R. I., 26 March 1863. He was graduated at Brown University in 1884 and from 1884 to 1888 studied at Johns Hopkins, where he received the degree of Ph.D. in 1890. In 1888–90 he was instructor in political economy; in 1890–98, associate professor, and since 1898 professor at Brown University. He is a member of the American Economic Association, of which he was vice-president in 1897–98, and has published 'Statistics of Municipal Finance' (in publications of the American Statistical Association, New Ser., No. 6, 1889 and in publications of American Economic Association, New Ser., No. 2, 1899).

GARDNER, Percy, English archæologist: b. Hackney, Middlesex, 24 Nov. 1846. He was educated at Cambridge University, was Disney professor of archæology there in 1880 and has been professor of classical archæology at Oxford since 1887. Among his publications are 'Samos and Samian Coins' (1882); 'The Types of Greek Coins' (1883); 'New Chapters in Greek History' (1892); 'Manual of Greek Antiquities,' with Jevons (1895); 'Sculptured Tombs of Hellas' (1896); 'Exploratio Evangelica' (1899); 'Historic View of the New Testament' (1901); 'A Grammar of Greek Art' (1905); 'The Growth of Christianity' (1907); 'Religious Experience of Saint Paul' (1911); 'Principles of Greek Art' (1913).

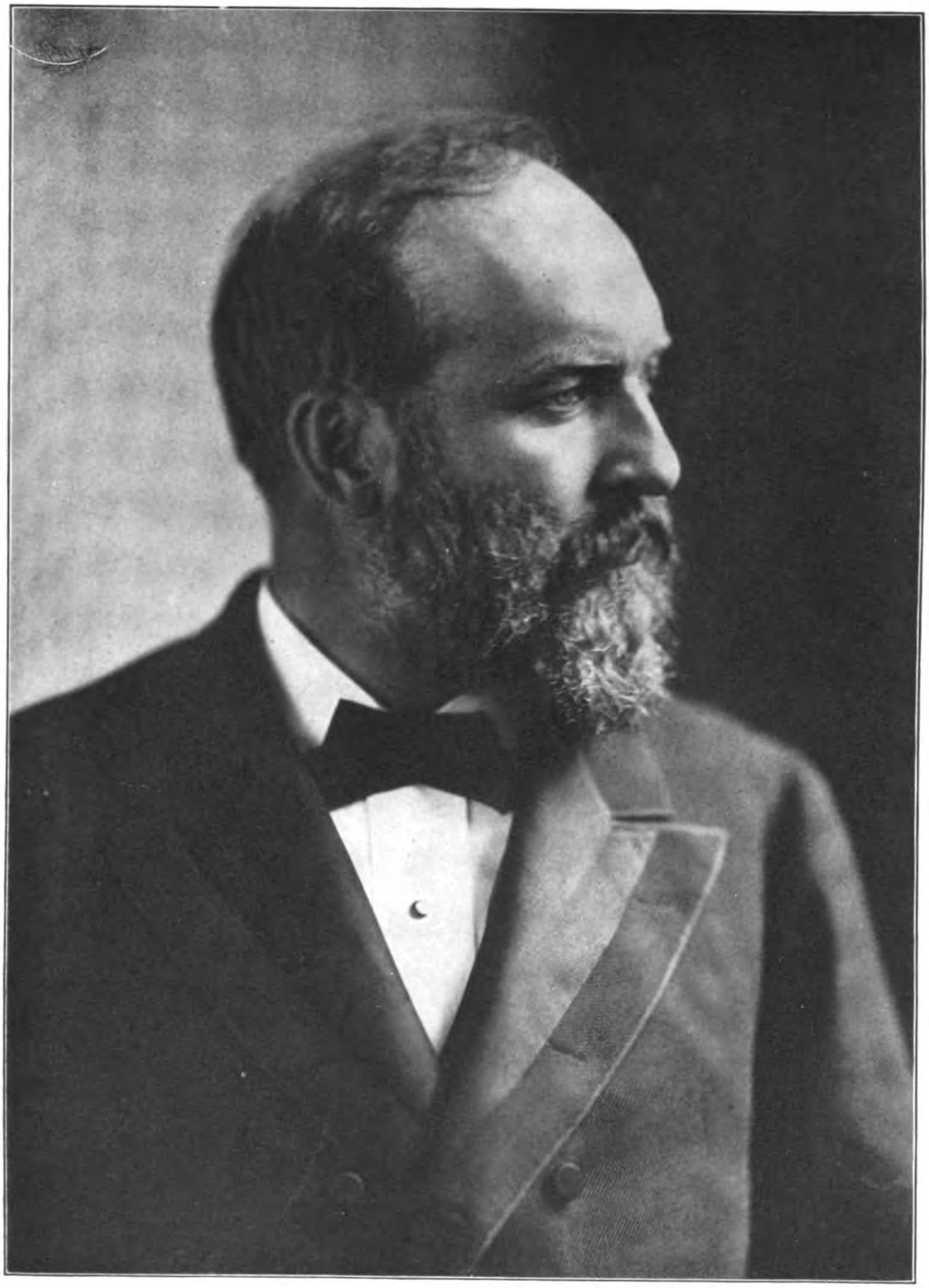
GARDNER, Mass., a town in Worcester County, including the villages of Gardner Centre, South Gardner and West Gardner. It is situated about 25 miles north of Worcester, on the Fitchburg division of the Boston and Maine Railroad, two branches of which pass through the town, intersecting at the station in Gardner Centre. Gardner is the trade centre of an agricultural region and has a large chair-manufacturing industry, with establishments employing about 3,000 people. Almost every known kind of chair is made here, and the products of this manufacture are shipped to all parts of the United States and to many foreign countries. The number of industrial establishments in 1914 was given in the Census Bureau's summary as 64; persons engaged in manufactures, 4,245; proprietors and firm members, 49; salaried employees, 232; wage earners, 3,964; primary horse power, 5,046; capital, $13,534,000; services, $2,447,000; salaries, $363,000; wages, $2,084,000; materials, $3,079,000; value of products, $7,450,000; value added by manufacture, $4,371,000. The town has two good parks and an excellent public library. Pop. 16,000.

GAREFOWL. See GREAT AUK.

GARFIELD, Harry Augustus, American educator and public official: b. Hiram, Portage County, Ohio, 11 Oct. 1863. He is a son of James A. Garfield, 20th President of the United States; was educated at Williams College, where he was graduated in 1885. In 1885–86 he taught Latin and Roman history at Saint

Paul's School, Concord, N. H., and practised law in Cleveland from 1888 to 1903. From 1891 to 1897 he was professor of contracts at the Law School of Western Reserve University; in 1903–08 was professor of politics at Princeton, and in the latter year was appointed president of Williams College. In 1908–09 he was president of the Cleveland Chamber of Commerce and in 1896 helped to organize the Cleveland Municipal Association, of which he was afterward president. In 1917, soon after the entrance of the United States into the World War, President Wilson appointed Mr. Garfield fuel controller. Because of the shortage of coal in the Northeastern States, especially New York City, and in Ohio, his administration of the office was severely criticized in the press, but Congressional investigation showed that the shortage was due to failure of the railroads to meet the extra demands upon them, and the situation cleared soon after Federal control of the roads was instituted, 28 Dec. 1917.

GARFIELD, James Abram, 20th President of the United States: b. Orange, Cuyahoga County, Ohio, 19 Nov. 1831; d. Elberon, N. J., 19 Sept. 1881. On his father's side he was of English Puritan descent; on his mother's, Huguenot. The father, a native of New York, settled in the «Western Reserve» in 1830 and died in 1833, leaving his widow with four small children, James being the youngest. Garfield's boyhood was passed amid the harsh but by no means destitute conditions of frontier life. He worked hard on the farm, helped in the support of the family, attended school three months each winter and read and reread every book which fell in his way. For a short time he was a driver and steersman on the Ohio Canal. Supporting himself chiefly by teaching, he studied successively at Geauga Seminary 1849, Eclectic Institute, Hiram, Ohio (now Hiram College), 1851–54, and Williams College, Mass., entering the junior class in 1854 and graduating with high honors in 1856. Returning to Ohio, he taught the classics at Hiram Institute 1856–57, and became its president 1857–59. Coincident with his teaching he studied law, was admitted to the bar in 1859 and, resigning his presidency, was elected to the Ohio State senate. The Civil War breaking out, he threw himself enthusiastically into the Northern cause, was commissioned lieutenant-colonel of the 42d Ohio and given command of a brigade, with orders to operate as an independent force in eastern Kentucky, December 1861. With a force of 1,100 men and no artillery he signally defeated 5,000 Confederates under the veteran general Humphrey Marshall, driving them from fortified positions of their own choosing, 10 Jan. 1862. For this exploit Lincoln promoted him brigadier-general. Subsequently he took part in the battle of Shiloh, in the operations around Corinth, and served with distinction on several courts-martial at Washington, one being that of Gen. Fitz-John Porter (q.v.). Appointed chief of staff to General Rosecrans, February 1863, his notable services at Chickamauga (see CHICKAMAUGA, BATTLE OF) caused Lincoln to make him a major-general, 19 Sept. 1863. In 1862 his home district had elected him to Congress. Thus, within six years he had been president of a college, State senator, major-general and representative-elect, a combination of honors without parallel in the national annals. Upon the advice of Lincoln and Stanton he resigned his major-general's commission 5 Dec. 1863 and took his seat as a representative on December 7. In this field his talents and genius found their true sphere. He stepped to the front at once, taking a prominent part in every debate of importance and becoming an authority on questions of finance, tariff, education and constitutional rights. Always the champion of sound money, his speech in March 1866 clearly outlined the policy which resulted in the resumption of specie payments 1 Jan. 1879. An eminent contemporary has well said of Garfield's speeches, that they are a compendium of the political history of the time and would give a connected history and complete defense of the important legislation of the 17 eventful years that comprised his legislative career. He was eight times re-elected to Congress, serving on such important committees as those on military affairs and on ways and means, and was the first chairman of the Committee on Banking and Currency. In the Reconstruction period he steadily opposed the theories of President Johnson (see JOHNSON, ANDREW); in 1876 he went to New Orleans at President Grant's request to watch the counting of the Louisiana vote, and in 1877 was chosen by acclamation one of the two members of the Electoral Commission allotted to the House of Representatives. In the 45th Congress Garfield displayed masterly qualities as a leader of opposition. His speech at Faneuil Hall, Boston, in 1878 on the national finances was circulated by thousands as a campaign document. On 13 Jan. 1880 the Ohio legislature unanimously elected him United States senator to succeed Hon. Allen G. Thurman (q.v.), and his last speech in Congress was delivered 23 April 1880. At the Republican National Convention at Chicago, 2–8 June 1880, he headed the Ohio delegation, nominated John Sherman (q.v.) for the Presidency, opposed the nomination of General Grant for a third term and was himself nominated on the 36th ballot as a compromise candidate. Contrary to all precedent, Garfield himself took part in the campaign that followed, making some 70 speeches in all, chiefly extemporaneous. At the November election he received 214 electoral votes to 155 given his Democratic opponent, General Hancock. The first months of Garfield's administration were disturbed by the opposition of the New York senators to certain of his appointments. Senators Conkling and Platt claimed the right to control the Presidential appointments in their State. This the President refused to concede. The senators resigned and appealed to their legislature to vindicate their attitude by a re-election, but failed to get it. On the morning of 2 July 1881, while in the Baltimore and Potomac station at Washington, on his way to New England, where he intended to deliver the commencement address at Williams College, President Garfield was shot by Charles Jules Guiteau (q.v.), a disappointed office-seeker. For weeks he lingered between life and death, suffering the greatest agony but bearing it with a magnificent fortitude that won the admiration and sympathy of the civilized world. A removal to Elberon, N. J., in the hope that the sea air



JAMES ABRAM GARFIELD

Twentieth President of the United States

might benefit him was of no avail. Blood poisoning set in on 15 September and he died on the 19th at 10.30 P.M. In February 1882 an impressive memorial service was held in the House of Representatives, the Hon. James G. Blaine delivering a commemorative address, which for eloquence, dignity and truth has rarely been equaled on such occasions. Garfield's body lies in a beautiful cemetery in Cleveland, Ohio, a stately monument marking the spot. His life was the fullest realization of the opportunities of American citizenship. Rising from nothing, by his own exertions he won high places in various spheres and filled them all adequately and with dignity. His 'Works' have been edited by Prof. B. A. Hinsdale (Boston 1882–83). Consult Hinsdale, 'President Garfield and Education' (Boston 1882).

W. N. C. CARLTON,
Librarian, Newberry Library, Chicago.

GARFIELD, James Rudolph, American government official, son of President James A. Garfield: b. Hiram, Ohio, 17 Oct. 1865. He was graduated at Williams College in 1885; studied at the Columbia Law School and in 1888 was admitted to the bar. In 1896–99 he was a member of the Ohio senate and in 1902–03 was a member of the United States Civil Service Commission. From 1903 to 1907 he was commissioner of corporations of the United States Department of Commerce and Labor and in 1907 became Secretary of the Interior in President Roosevelt's Cabinet. He retired from this post on 4 March 1909; during his term of office, he effected a complete reorganization of the department and instituted many land-office reforms. Since 1909 he has been engaged in law practice at Cleveland; in 1912 he was prominent in the councils of the new Progressive party.

GARFIELD, N. J., borough of Bergen County, opposite Passaic, on the Passaic River, and on the Erie Railroad, 10 miles northwest of New York. It contains machine shops, embroidery works, knitting mills, woolen mills and stone works, and there are manufactures of wax paper, chemicals, rubber goods, paper boxes, perfumes and clothing. In 1914 there were in operation 39 establishments with an aggregate capital of $16,083,000 and employing 6,144 persons. Salaries and wages amounted to $3,113,000. The products were valued at $16,113,000, of which $4,748,000 was added by manufacture. Garfield was incorporated in 1898; the government is vested in a mayor and council. The water plant is municipally owned. Pop. 15,455.

GARFIELD MONUMENT, a monument erected as a memorial to President Garfield, in the Lakeview Cemetery at Cleveland, Ohio. See CLEVELAND.

GARGANO, gär-gä'nō (ancient Garganus), a mountainous peninsula, the «spur» of Italy, in the province of Foggia, jutting out into the Adriatic Sea, and attaining in Monte Calvo a height of nearly 4,000 feet. Bee-keeping is yet as generally engaged in as in the time of Horace. The district is visited mainly by pilgrims to a shrine of Saint Michael on Monte Saint Angelo. It is about 50 miles long and 27 miles broad.

GARGANTUA AND PANTAGRUEL (*La Vie très horrifique du grand Gargantua and Pantagruel, roi des Dipsodes*) is the literary monument of François Rabelais. The significance of the work for its time is likely to be misapprehended by readers grown more squeamish, even in speaking, than he was in writing or printing, of matters concerning the processes of engendure, gestation, nutrition, digestion and excretion, while they have become heedless, through long and wonted use, of those liberties in education and in the saner social, political and intellectual outlook for which our age is indebted most to Rabelais and to Erasmus among the humanists of the 16th century. In the coarseness with which he expresses a lusty animalism, Rabelais had rivals but hardly an equal. Yet in the whole of his work there is not a prurient phrase. He likens (Bk. 1, Prologue) his work to a «silene,» i.e., to a little fancy box whose grotesquely ornamented lid hid some prized thing, a jewel perhaps, a spice, some healing salve. What is hidden is worth more than what appears. Let his readers «break the bone and suck out the marrow.»

The dates and even the order of publication of the five books that make up the current 'Gargantua and Pantagruel' are uncertain. Book 2, the first of 'Pantagruel' was certainly in print in 1533, as was the 'Pantagrueline Prognostication,' a parody of the current popular almanacs. Book 1, 'Gargantua,' is known first in an edition of 1535. A rather commonplace chap-book, 'The Grand and inestimable chronicles of the great and enormous giant Gargantua' is at least as early as 1532. Giant Gargantua was already a familiar figure in the folklore of France. Whether these 'Chronicles' are by Rabelais, or whether perhaps some other earlier 'Gargantua' by him has left no trace, is uncertain. A new edition of Books 1 and 2 appeared in 1542, the very important Book 3 in 1546. A part of Book 4 appeared in 1547, while Rabelais was in exile, the whole of it after his restoration to royal favor in 1552. Meantime a version of the much disputed Book 5 had appeared in 1549. The current version of this Book was first printed in 1562 and not incorporated with the other four till 1567. This latter version is at least sophisticated; possibly neither is genuine.

The work changed in character as it progressed. It began as a narrative of Brobdingnagian folk-lore, with sallies of ebullient animal spirits and passages of shrewd observation and deep wisdom regarding the errors and shortcomings of the time in education and in political, social and religious life. As the work proceeds these latter elements become more and more prominent, and with the development of the character of Panurge in Book 3, it grows clearer why Coleridge should speak of «the moral elevation of Rabelais' work» and rank him «with the creative minds of the world, Shakespeare, Dante, Cervantes.» Humor is the book's shell. Rabelais, with Erasmus and Hutten, killed obscurantism with laughter. But wisdom is its kernel. His insight into and sympathy with human nature, joined to his classical scholarship, shook a drowsing Europe to awakened intellectual life. Especially to be noted are the passages on education (Bk. 1; 14, 15, 21–24); those that tell of the words and deeds of the redoubtable Friar John of the Funnels, better, «of the Choppers» (Bk. 1; 27, 39–45) and his abbey of Theleme (Bk. 1; 52–57); Gargantua's letter of counsel to Pantagruel (Bk. 2; 8); the latter's encounter with the Limousin pedant (Bk. 2; 6); and with Panurge (Bk. 2; 9); Panurge's praise of debt (Bk. 3; 3–5) and his famous search for light on the question of his marriage, which, with many digressions, is the binding thread for the rest of the work. The key-note is its militant faith in human nature and liberty, informed by free thinking and free teaching, joined to a Greek aversion to ascetic restraint. Never was there a more robust believer that life for its own sake could be made worth living.

Among many annotated editions of Rabelais may be noted those by Marty-Laveaux (1870–81), by Montaiglon and Lacour (1868–72), by Moland (1881), by Clouzot (1912) and by Lefranc and others (unfinished, 1912–). The best-known translation was begun by Sir Thomas Urquhart and completed by Peter Le Motteux (1653–94). It has been often reprinted, notably with an introduction by Whibley (Tudor translations, 3 vols., 1900). W. F. Smith's annotated version (2 vols., 1893) is more accurate. Consult Tilley, ‘Rabelais’ (1907); Paillard, ‘L'Œuvre de Rabelais’ (1910); Stapfer, ‘Rabelais’ (1889); Gebhard, ‘Rabelais, le renaissance et le réforme’ (1877), and ‘Revue des études rabelaisiennes’ (1903–12) continued as ‘Revue des études du siezième siècle’ (1913–).

BENJAMIN W. WELLS.

GARGOYLE (Late Latin *gargula*, Old French *gargouille*, throat), a carved or moulded ornamental figure projecting at the upper part of a building, either connected with a water spout or in general design resembling those satirical figures which originally decorated water spouts. Thus, in ‘La Scultura nel Duomo di Milano’ (Milan 1908) we read that, contemporaneously with the locations of the first statues on parts of the exterior of Milan Cathedral, there began also the creation of those bizarre figures which enlivened the external architectonic organism. The Milanese gargoyles, «originating in the simple necessity of making channels for rainwater, became one of the most vivid and characteristic ornaments.» The important book devoted to this branch of art as exemplified at Rouen, Adeline's ‘Sculptures Grotesques et Symboliques,’ employing the word in its wider meaning, denominates both non-spouters and spouters *gargouilles*; and useful definitions are those by Canon Auber in the *Bulletin Monumental*: (a) Symbolic monsters, emblems of the paganism conquered by religion at Rouen, and (b) imitations of those chimerical animals, to conduct water from roofs. The 1608 edition of Withal's Dictionary has: «Gargels of men's figures, telamones, atlantes; gargels of women's figures, cariatides.» Mr. G. L. Hunter, in his ‘Notes on Gargoyles, Grotesques and Chimeras’ (*Architectural Record*, New York, February 1914) writes: «Gargoyles are as fundamentally Gothic as grotesques are Renaissance and chimeras are Classic.» Only by a perversion can the word *grotesque* be twisted from Renaissance to Gothic and substituted for gargoyle. «Even if *gargoyle* did mean the *spouter* only, the extension of its meaning to include all the Gothic satirical figures that throng the roofs and towers of Gothic buildings would be in line with the normal and natural development of language. All the more reason, then, for holding on to a meaning that is sanctioned by ancient general usage.» In the United States the day of the gargoyle and the grotesque in church decoration has gone by; secular architecture, however, retains and finds new applications for such «symbolic monsters.» Examples are seen at West Point, where one of the barracks is ornamented with quaint and humorous figures illustrating the development of war; at Princeton University, where (on a dormitory) are numerous interesting gargoyles designed by Mr. Borglum. One of the best modern examples of the free use of gargoyles and grotesques is seen at the College of the City of New York, whose buildings the architect has enriched with more than 600 figures, all different.

The highest-placed gargoyles in the world are those projecting from the 29th, 49th and 51st stories of the Woolworth Building in New York City. These, like other modern gargoyles, «do not spout even when in the horizontal position of water spouts. And unlike mediæval gargoyles, but like those of ancient Rome, they are made of terra cotta instead of stone, and consequently have the characteristics of moulded rather than of carved ornament.» Although not sufficiently numerous to be regarded as an important decorative feature of such an enormous structure, they certainly add to the attractive vitality of line, emphasize somewhat light and shade, and suggest the possibilities inherent in the employment of gargoyles on a larger and freer scale for the decoration of important commercial edifices.

GARIBALDI, gä-rē-bäl'dē, **Giuseppe**, Italian patriot: b. Nice, France, 4 July 1807; d. island of Caprera, Italy, 2 June 1882. His father being a poor fisherman he received little education, and for a number of years was a sailor on various trading vessels. In 1834, being condemned to death for his share in the schemes of Mazzini, he escaped to Marseilles and finally went to South America. In the service of the Republic of Rio Grande against the Brazilians he became known as a brilliant leader, and with his famous Italian legion he subsequently gave the Montevideans such effective aid against Buenos Aires as to earn the title of «hero of Montevideo.» While in South America, he married his first wife, Anita, who shared his dangers and privations. In 1848, on hearing of the rising against Austria, he returned to Italy, raised a band of volunteers and harassed the Austrians till the re-establishment of Austrian supremacy in Lombardy. In the spring of 1849 he proceeded to Rome to support Mazzini's republic. He was appointed to command the forces, but the odds were overwhelming, and after a desperate defense of 30 days Garibaldi escaped from Rome with 4,000 of his followers, and made a daring retreat through territory occupied by Austrian forces. Garibaldi, accompanied by his wife, ultimately set sail for Venice; but being pursued by Austrian vessels, was forced to land, when his wife succumbed and was buried in the sand. He reached the United States, and was for several years in command of a merchant vessel. He then purchased a part of the small island of Caprera, off the north coast of Sardinia, and made this his home for the rest of his life. Latterly the subscriptions of his admirers enabled him to become owner of the whole island.

In the war of 1859, Garibaldi and his Chasseurs of the Alps did splendid service; and on the revolt of the Sicilians in 1860 he crossed to the island, wrested it after a fierce struggle from the king of Naples, recrossed to the mainland and occupied Naples, where he was proclaimed dictator of the Two Sicilies. He readily acquiesced in the annexation of the Two Sicilies to Italy, and declining all honors, retired to his island farm. In 1862 he endeavored to force the Roman question to a solution, and entered Calabria with a small following, but was taken prisoner at Aspromonte by the royal troops. He was soon released, however, and returned to Caprera. In 1864 he received an enthusiastic welcome in Great Britain. In 1866 he commanded a volunteer force against the Austrians in the Italian Tyrol, but failed to accomplish anything of consequence. Next year he attempted the liberation of Rome, but near Mentana was defeated by the French and pontifical troops, and was again imprisoned by the Italian government, but soon pardoned and released. In 1870 he gave his services to the French republican government against the Germans, and at the end of the war was elected a member of the French Assembly, but speedily resigned his seat and returned to Caprera. Rome now became the capital of united Italy, and here in January 1875, Garibaldi took his seat in the Italian Parliament. The latter part of his life was spent quietly at Caprera. His second wife was the Countess Raimondi, whom he married in 1860; but the union was an ill-assorted one; and his third wife was Francesca, a peasant. After 1870 he wrote two or three novels of very mediocre quality. His autobiography was published in 1887, and translated into English with a supplementary biography in 1889.

Bibliography.— Dwight, 'Life of Garibaldi; from his Private Papers' (new ed., New York 1903); Bent, 'Life of Garibaldi' (London 1881); Guerzoni, 'Garibaldi' (2 vols., Florence 1881); and G. N. Trevelyan's admirable works, 'Garibaldi's Defence of the Roman Republic' (New York 1907); 'Garibaldi and the Thousand' (New York 1909); and 'Garibaldi and the Making of Italy' (New York 1911).

GARIBALDI (fish), a small, brilliantly colored, edible fish (*Hypsypops rubicundus*), scarlet when adult, which dwells in rocky pools along the coast of southern California, hiding and finding its food among the seaweeds.

GARIBALDI HYMN, the popular, though not official, national anthem of Italy. The real national air is the «Marcia Reale,» or Royal March. The other, known originally as the «Inno di Guerra dei Cacciatori delle Alpi» (War Hymn of the Alpine Hunters) was written by the poet Luigi Mercantini (1821–72), and is now called «l'Inno di Garibaldi» (since 1860). The music is by a military bandmaster, Alessio Olivieri; it is thoroughly Italian in spirit, being mainly a parade march with a dash of operatic aria. The words are:

All' armi! all' armi!
Si scopron le tombe, si levano i morti,
I martiri nostri son tutti risorti,
Le spade nel pugno, gli allori alle chiome,
La fiamma ed il nome d'Italia sul cor!
Corriamo, corriamo, su o giovani schiere!
Su al vento per tutto le nostre bandiere!
Su tutti col ferro! su tutti col fuoco!
Su tutti col fuoco d'Italia nel cor.
Va fuori d'Italia, va fuori ch'è l'ora,
Va fuori d'Italia, va fuori o stranier!

All'armi! all'armi!
La terra dei fiori, dei suoni, dei carmi,
Ritorni qual era la terra dell'armi;
Di cento catene ci vinser la mano,
Ma ancor di Legnano sa i ferri brandir.
Bastone tedesco l'Italia non doma,
Non crescono al gioco le stirpe di Roma;
Più Italia non vuole stranieri e tiranni
Già troppo son gli anni che dura il servir.
Va fuori d'Italia, va fuori che'è l'ora,
Va fuori d'Italia, va fuori o stranier!

Le case d'Italia son fatte per noi,
È là sul Danubio la casa de tuoi.
Tu i campi ci guasti, tu il pane c'involi,
I nostri figlinoli — per noi li vogliam.
Son l'Alpi e i due mari d'Italia i confini,
Col carro di fuoco rompiam gli Appennini:
Distrutto ogni segno di vecchia frontiera,
La nostra bandiera per tutto inalziam.
Và fuori d'Italia, etc.

The following translation, in blank verse, closely imitates the original, without attempt at rhyme:

To arms! The graves open, the dead arise,
Our martyrs all are resuscitated
With swords in hand, and laurels on their brow,
The flame and name of Italy in the heart.
Haste! haste! up, ye marshalled youth!
On every wind our banners fly!
Rise all with arms, all with fire!
Rise all with the fire of Italy in your hearts!
Depart from Italy, go, the hour has struck!
Out of Italy depart, Oh stranger!

To arms! The land of flowers, melody and poets,
Once more be a land of arms;
A hundred chains here bind the hand,
But Legnano* yet knows how to wield the sword!
German cudgel-blows cannot Italy tame,
The Roman stock was not raised to that game;
No more foreign tyrants will Italy bear,
Too many years has the servitude endured.
Depart from Italy, etc.

The homes of Italy are built for us,
Your home is away on the Danube;
You ravage our fields, you steal our bread,
Our own sons we want ourselves.
The Alps and the two seas are Italy's borders;
With fire we break through the Appennines;
Destroyed every sign of the old frontier,
Our flag shall be raised over all.
Depart from Italy, etc.

GARIGLIANO, gä-rēl-yä'nō, a river in southern Italy, formed by the junction of the Liri and Sacco near Pontecorvo. It flows southeast and southwest, and after a course of 40 miles falls into the Gulf of Gaëta.

GARLAND, Augustus Hill, American lawyer: b. near Covington, Tenn., 11 June 1832; d. Washington, D. C., 26 Jan. 1899. He opposed secession as a policy, but was afterward elected to the Confederate Senate, which office he held till the close of the war. In 1874 he was elected governor under the new constitution of Arkansas, and in 1885 became Attorney-General in the Cabinet of President Cleveland.

* Legnano, an ancient "borgo" of Lombardy, celebrated in history as the final scene of the great struggle for Italian liberty in 1176 against Barbarossa. The word "German" in the next line refers to the Austrians.

GARLAND, Hamlin, American lecturer and novelist: b. near West Salem, Wis., 16 Sept. 1860. When about 16 he became a pupil at the Cedar Valley Seminary, Osage, Iowa, though working as usual on the farm during six months of the year. He was graduated in 1881 from this school and for a year tramped through the Eastern States. He farmed and taught in Illinois and Dakota, went to Boston in 1884, intending to further qualify himself for teaching. He became a pupil and later an instructor in the Boston School of Oratory. During 1885–89 he taught classes in English and American literature and lectured on Browning, Shakespeare, The Drama, etc. In 1893 he took up residence in his native village of West Salem. Here he has resided ever since. A part of each year, however, is spent by the author in mountain traveling. His first book was 'Main-Traveled Roads' (1890), frankly realistic fiction. Somewhat similar in character are 'A Spoil of Office' (1892); 'Prairie Folks' (1893); 'A Little Norsk' (1891); 'Rose of Dutcher's Coolly' (1895). Other works are 'Jason Edwards' (1891); 'A Member of the Third House' (1892); 'Wayside Courtships' (1897); 'Her Mountain Lover' (1901). He has also written a volume of criticism entitled 'Crumbling Idols' (1894); 'Prairie Songs' (1894), a volume of verse; 'Ulysses Grant: His Life and Character' (1898); 'The Eagle's Heart' (1900); 'The Captain of the Gray Horse Troop' (1902); 'Hesper' (1903); 'The Light of the Star' (1904); 'The Tyranny of the Dark' (1905); 'Victor Olnee's Discipline' (1911); 'Forester's Daughter' (1914). He is vice-president of the National Institute of Arts and Letters, a member of the Players' Club and the originator and first president of the Cliff Dwellers, the leading artistic and literary club of the West. He is a persistent advocate of national character in fiction and in music.

GARLIC (*Allium sativum*), a species of onion long in cultivation. The leaves are grass-like, and differ from those of the common onion in not being fistulous. The stem is about two feet high, terminated by a head composed principally of bulbs instead of flowers; the flowers are white; the root is a compound bulb, consisting of several smaller bulbs, commonly denominated cloves, enveloped by a common membrane. Garlic has a strong, penetrating odor and a pungent acrid taste. It differs from the onion only by being more powerful in its effects. In warm climates, where garlic is considerably less acrid than in cold ones, it is much used both as a seasoning and as food. In the south of Europe, particularly in Spain, and among Italians in the United States, it enters into the composition of almost every dish, not only among the common people, but among the higher classes of society. At all times, however, while it has been prized by some nations it has been detested by others, as by the ancient Greeks. Its cultivation is easy, and it is reproduced by planting the radical or floral bulbs. Its medicinal virtues are celebrated.

GARLIC, Oil of. When the leaves, seeds or bulbs of garlic and other allied plants are distilled with steam, about 0.2 per cent of a brown oil, with acrid taste and strong disagreeable odor, passes over. By purification it is obtained as a pale yellow oil having the odor of garlic, and it is then found to consist of the sulphide of allyl $(C_3H_5)_2S$. This oil is nearly related to the pungent oil of mustard, C_3H_5NCS, an isomer of the sulphocyanide of allyl, and is of much interest chemically, but it is of no importance from an industrial point of view.

GARMAN, Harrison, American naturalist: b. Lena, Ill., 27 Dec. 1858. Educated in the public schools and the State Normal University; studied later at Johns Hopkins University. He has held many professional positions, among them, first assistant in the Illinois Laboratory of Natural History and associate professor of zoology in the University of Illinois and is now professor of entomology and zoology of Kentucky State University. He has been State entomologist of Kentucky since 1897. He has written numerous articles on botany, zoology and entomology.

GARMAN, Samuel, American naturalist: b. Indiana County, Pa., 5 June 1846. He was graduated at the Illinois State Normal University in 1870, and became assistant in herpetology and ichthyology in the Museum of Comparative Zoology, Cambridge, Mass., in 1873. His works include 'Fishes and Reptiles from Lake Titicaca' (in *Bulletin* Museum Comp. Zoology, Vol. III, 1871–76) and, as joint author, 'Exploration of Lake Titicaca' (same volume of that *Bulletin*).

GARNEAU, gär'nō, **François Xavier,** French-Canadian historian: b. Quebec, 1809; d. 1866. Educated in his native city, he became a notary in 1830, and devoted his leisure to making researches into the history of Canada. In 1831 he went to England and returned to Quebec in 1833. He afterward became translator to the legislative assembly of Lower Canada and city clerk of Quebec. His 'Histoire du Canada,' published in four volumes, recounts the story of all the French colonies in North America until 1763, and from that date deals with Canada only. Its publication gave a great impetus to literary productivity in French Canada.

GARNER CASE, 1856, the most tragic of the fugitive-slave cases. Simon Garner, his wife, and his son Robert, slaves of John Marshall of Kentucky, and Robert's wife Margaret and their four children, slaves of A. R. Gaines, ran away, crossed the Ohio on the ice, and took refuge with a Cincinnati colored man. Gaines tracked them, secured a warrant, and with a deputy marshal and a band of assistants attacked the house. After a desperate fight the fugitives were overpowered, one of the posse being badly wounded; but Margaret, who had shared in the conflict, found time before her capture to murder one of the children, severely cut the throats of two others, and considerably bruised the baby, to keep them from returning to slavery. In sympathy with them, and to establish their freedom as denizens of Ohio, a Cincinnati judge issued a writ of habeas corpus, and the grand jury indicted Margaret for the murder of her child, and her husband and his father as accessories. The United States Fugitive Slave Law of 1850 prevailed, however; the slaves were given back to their owners and sent down the river. On the voyage Margaret jumped overboard with the baby; she was rescued, but the child was lost, at which she expressed satisfaction.

GARNET, Henry Highland, Afro-American clergyman: b. New Market, Md., 1815; d. 1882. He was born in slavery and at the age of 10 was brought to New York by his parents, who effected their escape from slavery. He received his education at Canaan Academy and at Oneida Institute. He was made pastor of a Presbyterian Church in Troy, N. Y. in 1842. He became prominent among the Abolitionists and for many years edited the *Clarion*, a weekly periodical advocating the abolition of slavery. He lectured on slavery in Great Britain in 1850–53 and for the next two years was missionary in Jamaica under the protection of the United Presbyterian Church of Scotland. From 1855 to 1865 and again from 1869 to 1881 he was pastor of Shiloh Presbyterian Church in New York. In 1865–69 he held a pastorate in Washington, D. C. In 1881 he was made Minister and Counsel-General to Liberia, and died within a few months after his arrival in that republic.

GARNET. See GEMS; MINERAL PRODUCTION OF THE UNITED STATES.

GARNETT, James Mercer, American educator: b. Aldie, Va., 24 April 1840; d. Baltimore, Md., 18 Feb. 1916. He was graduated at the University of Virginia in 1859. He served with the Confederate army during the Civil War and rose to be a captain of artillery. During 1869–70 he studied in Berlin and Leipzig, and in 1870 was appointed president of Saint John's College, Annapolis, which post he occupied for 10 years. Following this he taught at the University of Virginia and the Woman's College in Baltimore. He was a former president of the American Philological Association, and vice-president of the Modern Language Association. For many years he was a member of the University Club of Baltimore. He edited 'Selections in English Prose' (1891); and published a 'Translation of Beowulf' (1882; 6th ed., 1900), a literal version in metre resembling the original; 'Elene and Other Anglo-Saxon Poems' (1889–1900); and a 'History of the University of Virginia' (1901).

GARNETT, Richard, English poet and librarian: b. Lichfield, Staffordshire, 27 Feb. 1835; d. London, 13 April 1906. He was appointed in 1851 assistant in the printed book department of the British Museum, became superintendent of the reading-room in 1875, but resigned in 1884 to devote himself more exclusively to the printing of the 'Museum Catalogue,' of which he had had charge from its commencement. He published 'Primula: a Book of Lyrics' (1858); 'Io in Egypt and Other Poems' (1859); 'Poems from the German' (1862); 'Relics of Shelley' (1862); 'Idylls and Epigrams' (1869); 'Selections of Shelley's Poems' (1880); 'Letters' (1882); 'Life of Carlyle' (1887); 'Life of Emerson' (1887); 'Twilight of the Gods' (1888); 'Life of Milton' (1890); 'Iphigenia in Delphi' (1891); 'Poems' (1893); 'William Blake: Painter and Poet' (1895); 'The Age of Dryden' (1895); 'One Hundred and Twenty-four Sonnets from Dante, Petrarch and Camoens' (1896); 'Richmond on the Thames' (1896); 'Life of Edward Gibson Wakefield' (1898); 'History of Italian Literature' (1898); 'Essays in Librarianship and Bibliography' (1899); 'The Queen and Other Poems' (1901); 'Essays of an Ex-Librarian' (1901); and, with Edmund Gosse, 'English Literature' (1903–04). He also contributed extensively to the magazines and cyclopedias. He resigned from the Museum in 1899.

GARNETT, Robert Selden, American soldier: b. Essex County, Va., 16 Dec. 1819: d. Carrick's Ford, Va., 13 July 1861. Graduated from the United States Military Academy in 1841 and made brevet second lieutenant of artillery, he served on the northern frontier during the Canadian border disturbances, and distinguished himself in the war with Mexico (1846–48), receiving the brevet of major for his conduct at Buena Vista. He was transferred to the Seventh Infantry in 1848, fought in Florida against the Seminoles, and was commandant at West Point in 1852–54. In 1855 he was promoted major of infantry, and in 1856 commanded the expedition against the Indians of Puget Sound. At the outbreak of the Rebellion in 1861 he resigned his commission, and was made adjutant-general, with colonel's rank, to organize the Virginia forces. Shortly afterward he was appointed brigadier-general, C. S. A., and given command of the troops in the western part of Virginia. While endeavoring to retreat to Beverly, he was overtaken by the Federals at Carrick's Ford, Cheat River, and took command of a detachment with which he sought to cover the retreat. His force was routed, and he was killed during the combat.

GARNETT, Kan., city and county-seat of Anderson County, on the Pottawattomie River, and on the Missouri Pacific and the Atchison, Topeka and Santa Fe railroads, 45 miles northwest of Fort Scott. It has good educational institutions, including a United Presbyterian college; large manufactures of furniture, flour, lumber and cheese. It adopted the commission form of government in 1913. Pop. 2,334.

GARNIER, gär'nyā', Charles, Jesuit missionary: b. Paris, 25 May 1606; d. 7 Dec. 1649. He was educated at the Jesuit College of Clermont and joined the order in 1624. In 1636 he was sent to the Canadian mission at his own request. He went to the Hurons and spent 14 years among them. In 1637, again in 1639 with Jogues, and later with Pijart — he attempted the conversion of the Tobacco nation and finally was successful. In 1646 they asked for the black robes and Garnier went to dwell with them until his death. In 1649 the Iroquois attacked the Tobaccos and during the massacre of Saint John's village Garnier was slain while ministering to the wounded. Parkman compares his life to that of Saint Peter Claver among the blacks, and calls it a voluntary martyrdom. Consult Bressau, 'Les Jésuites martyrs du Canada' (Montreal 1877); Martin, 'Vie manuscrite et lettres du Pére Garnier.'

GARNIER, Jean Louis Charles, French architect: b. Paris, 6 Nov. 1825; d. 4 Aug. 1898. He was a pupil of Leviel and Lebas at the Beaux-Arts, won the Prix de Rome in 1848 with his design for a conservatory of arts and industries, traveled in Italy, Turkey and Greece, and in 1861 won the competitive prize for plans of the new Paris Opera. In 1863–74 he superintended the construction of this costly and important work, whose chief feature is its grand staircase, but which is by some thought to be overladen with accessories of painting and sculpture. In addition to this, his principal achievement, he designed buildings, public and private, at Paris and elsewhere. He was the author of 'Travers les Arts' (1869); 'L'habitation humaine,' with Ammann (1892); and editor 'Le nouvel Opéra de Paris' (1876–81).

GARNIER, Marie Joseph François, commonly known as FRANCIS, French explorer: b. Saint-Etienne, 25 July 1839; d. Hanoi, Tongking, China, 2 Dec. 1873. He entered the French navy, served in the war with China in 1860–62 and became a civil officer in the newly-established colony of Cochin-China. In 1866 he was appointed to assist Capt. Doudart de Lagrée in an exploring expedition which set out from the coast of Cambodia and proceeded through Yunnan to Shanghai, the purpose being to open a highway of trade. Garnier explored the river Mekong, and, on the death of Doudart de Lagrée, assumed command of the expedition, which he brought successfully along the Yangtse-kiang to Shanghai. The geographical societies of France and Great Britain bestowed numerous honors upon him. He took part in the defense of Paris in 1870–71, and again undertook explorations in China. The governor of Cochin-China empowered him to negotiate a treaty with the viceroy of Tongking. Upon the refusal of the viceroy to open negotiations, Garnier captured Hanoi, the capital, and achieved further victories with a force of but 120. He was finally killed in an ambush. His 'Voyage d'Exploration en Indo-Chine pendant 1866–68' (1873) is a notable book.

GARNIERITE, a green, amorphous mineral, one of the most important ores of nickel. It is a hydrous silicate of nickel and magnesium, the ratio of the two metals varying widely. It is soft and very brittle and has a specific gravity of 2.3 to 2.8. It is extensively mined in New Caledonia and also occurs in large quantities in Douglas County, Ore., and Jackson County, N. C. It was named after the French geologist, Garnier.

GARNISHMENT, in law, a process by which a third person, in whose possession the effects of the defendant are attached, is warned not to turn over such effects to the defendant, but to appear in court and give information. This process is controlled by statute in the States where it exists, and the demands of the statutes must be fully met by any plaintiff seeking to make use of the process. A corporation's debts may not be garnisheed; neither may the process be invoked to interfere with a Federal court's judgment. The process is called in some States trustee process, in others factorizing, and in still others attachment, the more general title. The third party, who is known as the garnishee, is liable for only such property as is not encumbered by trusts and may be delivered by the officer serving said process. Virtually, the process is a secondary suit brought by the suing creditor against the third party, or garnishee, the creditor claiming the rights of the defendant in the primary action. Consult Rood on 'Garnishment' (1896). See ATTACHMENT; REPLEVIN.

GAROFALO, gä-rō'fä-lō, **Benvenuto** (originally BENVENUTO TISI DA GAROFALO), Italian painter: b. Ferrara, 1481; d. there, 6 Sept. 1559. In this city and in Cremona he cultivated his talents for painting; but the masterpieces of art in Rome exercised the greatest influence upon him. In the year 1505 he is said to have returned to Rome, and to have formed a very close intimacy with Raphael, who often made use of his assistance. He afterward painted for Alfonso I, in his native city. Garofalo's works show the influence of all the schools, particularly of the Lombard, and still more so of Raphael's, whom he surpassed in coloring. Most of his works are at Rome. Several of them, however, are in the galleries of Vienna and Dresden.

GAROFALO, Raffaele, BARON, Italian criminologist: b. Naples, 1852. He received his education at the University of Naples, became president of the Ferrara Civil Court, subsequently served as justice of the Naples Court of Appeals and finally became professor of criminal procedure and law at the University of Naples. He also prepared and edited material for a new code of procedure. He published 'Criminologia: studio sul delitto e sulla teoria della repressione' (1885; Eng. trans., by Millar 1914), and 'Riforma della procedura penale in Italia' (1889).

GARONNE (Lat. *Garumna*), a river of southwestern France, the chief one of that section, rising in the Pyrenees, at the foot of Mount Maladetta, in the Val d'Aran, within the Spanish border. It enters France at a distance of 26 miles from its mouth. The Garonne flows in a general northeasterly direction through the department of Haute-Garonne to Toulouse, whence it proceeds in a northwesterly course. Some 20 miles below Bordeaux it forms a junction with the Dordogne; it then takes the name Gironde, and enters the Atlantic Ocean by an estuary of 50 miles in length. The complete length of the river is about 400 miles. Ocean-going steamers may ascend to Bordeaux, and the river is navigable to Toulouse and beyond. From Toulouse the Canal du Midi extends to the Mediterranean. Several destructive floods have taken place, that of 1875 having caused special damage. With its 32 tributaries the Garonne offers a system of waterways navigable for more than 1,400 miles, — a total exceeding that afforded by any other French stream. The total drainage area approaches 38,000 square miles.

GARRARD, Kenner, American soldier: b. Cincinnati, Ohio, 1830; d. there, 15 May 1879. He was graduated from the United States Military Academy in 1851, was made brevet second lieutenant in the artillery, but in 1852 was transferred to the dragoons, and after service, largely in the Northwest, was made captain of cavalry in 1861. During the early part of the Civil War he was in the commissary-general's office at Washington, and in 1861–62 commandant at West Point. In September 1862 he was commissioned colonel of the 146th New York Volunteers, which he commanded at Fredericksburg, Chancellorsville and Gettysburg. For services in the last-named battle he was brevetted lieutenant-colonel. In 1863 he was promoted brigadier-general of the United States

Volunteers, and afterward he participated in the combat at Rappahannock Station and the Mine Run operations. He took part, also, in the invasion of Georgia, was brevetted colonel for services in the expedition against Covington, Ga., and from December 1864 to July 1865 commanded the second division of the 16th army corps. He distinguished himself by his efficiency in the battle before Nashville and in the operations against Mobile; led the storming column which finally captured Blakely (9 April 1865); and was in command of the district of Mobile in August–September 1865. Mustered out of the volunteer service in August 1865, he was assistant inspector-general of the Department of the Missouri in 1866, and in November 1866 resigned from the army, being at that time major, with the brevet of major-general for gallant and meritorious services in the field during the Rebellion.

GARRETT, Alexander Charles, American Protestant Episcopal bishop: b. Ballymot, County Sligo, Ireland, 4 Nov. 1832. He was graduated from Trinity College, Dublin, in 1855; was ordained priest in 1857; held the curacy of East Worldham, Hampshire, in 1856–59; was a missionary in British Columbia in 1859–69; rector Saint James', San Francisco, in 1870–72, and dean of Trinity Cathedral, Omaha, 1872–74. In 1874 he became missionary bishop of northern Texas, and subsequently bishop of Dallas. His publications include 'The Eternal Sacrifice'; 'Baldwin Lectures on the Philosophy of the Incarnation'; 'Historical Continuity' (1875).

GARRETT, Edmund Henry, American artist and author: b. Albany, N. Y., 19 Oct. 1853. Pupil of Laurens, Boulanger and Lefebvre. He has exhibited at the principal exhibitions in America and the Paris Salon. Medal, Boston 1890; was member jury, Saint Louis Exposition. He has published 'Elizabethan Songs' (1891); 'Victorian Songs' (1895); 'Three Heroines of New England Romance' (1894); 'Romance and Reality of the Puritan Coast' (1897); 'The Pilgrim Shore' (1900); 'Translation of Merimée's Carmen' (1896); 'Flowers of Fancy'; 'Roses of Romance.' He has received recognition in Italy for services to the Latin tongue.

GARRETT-ANDERSON, Mrs. Elizabeth, first English woman doctor: b. London, 1836; d. Aldeburgh, Suffolk, 17 Dec. 1917. She was one of the pioneers of that phase of the movement for the «emancipation» of women which aimed at throwing open to them the doors of the medical profession. Her attention was attracted to medicine by Miss Elizabeth Blackwell (q.v.), an Englishwoman who after many fruitless attempts was permitted to graduate M.D. of the University of Geneva, Beaver Falls, Pa. Miss Garrett, however, was the first woman to secure an English diploma. She began her medical studies in 1860, despite the fact that there was no school (in England) where she could be received, and no examining body willing to admit her to its examinations. The male students of Middlesex Hospital in London presented a memorial against the admission of women, and Miss Garrett was barred from that and other hospitals. Eventually the Society of Apothecaries authorized her to get her education privately from teachers of recognized medical schools, and finally gave her the desired qualification of L.S.A. in 1865, this being a genuine doctor's degree. She opened a dispensary for poor women and children in Marylebone, London, in 1866. Suddenly the Society of Apothecaries adopted a new rule which refused recognition of certificates granted for private studies, which made Miss Garrett's diploma void. She went to Paris, passed the examinations and returned to England with an M.D. degree in 1870. In 1870 she became a candidate at the London school board election, and was returned at the head of the poll for Marylebone, where her dispensary developed into the «New Hospital for Women and Children» in Euston road. She married in 1871. In 1874 she assisted in the establishment of the London School of Medicine for Women, in conjunction with her hospital of 26 beds. But the General Medical Council of England stipulated that only a general hospital of 150 beds could be recognized as adequate for teaching purposes. After three years of struggle and appeal, an alliance was formed between the Women's School of Medicine and the Royal Free Hospital in Gray's-in-road, which met the official requirements. The strenuous efforts of the devoted little band of women «would-be doctors» were rewarded in 1876 by an act of Parliament enabling British examining bodies to include women. Until 1892 Mrs. Garrett-Anderson was the only female member of the British Medical Association; in that year all restrictions were removed. Mrs. Garrett-Anderson was lecturer on medicine at the London School for Women for 23 years, and for over 24 years she was senior physician of the New Hospital for Women. In 1908 she was elected mayor of Aldeburgh, the first woman in England to receive that civic honor. Her son, Sir Alan Garrett-Anderson, succeeded Sir Eric Geddes as Controller of the Navy in August 1917; her daughter, also a doctor, was head of a military hospital in the European War.

GARRETT BIBLICAL INSTITUTE, the second oldest theological seminary of the Methodist Episcopal Church, located at Evanston, Ill. Although its plant is located on the campus of the Northwestern University it is not a department of the university. It has its own board of trustees, funds, property and library. It is, however, closely affiliated with the university. It was founded in 1855, through the liberality of Mrs. Eliza Garrett. Its first class graduated in 1858. It has had only six presidents in its long career: Dr. John Dempster, Bishop Matthew Simpson, Bishop W. Ninde, Dr. H. B. Ridgaway, Dr. Charles J. Little and Dr. Charles M. Stuart, the present incumbent. It has a faculty of 18 members, a student body in 1917–18 of 245. It has graduated 1,455 students and has had a total of over 3,700 students. Among its graduates and students are included nine bishops, 76 educators, 18 editors and 120 missionaries. It has not only prepared men for the Methodist ministry, but its men are serving in the Congregational, Presbyterian, Protestant Episcopal, Lutheran, Mennonite and other churches. In 1912 the school was divided into a Graduate School primarily for college men; and the Diploma School for men with less than collegiate training. In 1915 the quarter system was adopted, September being the only month when the seminary is not in session. In 1917 the first units of a new plant were erected which will ultimately cost a million dollars. The seminary owns considerable property in the city of Chicago. It has an endowment of over $948,000 and a library of 51,612 volumes.

GARRICK, David, English actor: b. Hereford, England, 19 Feb. 1717; d. London, 20 Jan. 1779. His grandfather was a French refugee, his father a captain in the army. He was educated at the grammar school at Lichfield. He gave an early proof of his dramatic tendency by inducing his school-fellows to act the 'Recruiting Officer,' in which he himself took the part of Sergeant Kite, being then only 12 years of age. Later he was placed with a brother under Dr. Samuel Johnson. In 1741 he joined Giffard's company at Ipswich, where under the name of Lyddal he played with uniform success.

At this time the stages of the metropolis were but indifferently supplied with leading performers, so that when Giffard, who was manager of a threatre in Goodman's-fields, introduced his accomplished recruit there, 19 Oct. 1741, the effect was immediate and decisive. He judiciously chose the part of Richard III, which did not require that dignity of person in which he was deficient, while it gave him scope for all the strong marking of character and changes of passion in which his principal excellence consisted. He at the same time adopted a natural mode of recitation, which was a daring innovation on the part of a new performer before audiences accustomed to the artificial declamation of the school which preceded him. He afterward visited Dublin, where his success was even greater than in the metropolis, and in 1745 became joint manager with Sheridan of a theatre there. In 1746 he was engaged for the season at Covent Garden, and at its close purchased Drury Lane, and opened it 15 Sept. 1747, with the 'Merchant of Venice,' to which Dr. Johnson wrote a prologue for the occasion. This period formed an era in the English stage, from which may be dated a comparative revival of Shakespeare, and a reform both in the conduct and license of the drama. In 1749 he married Eva Marie Violette (1724–1822), and his married life seems to have been happy. The next year (1750) he and Mrs. Bellamy were playing 'Romeo and Juliet' at Drury Lane, while Barry and Mrs. Cibber were giving the same play at Covent Garden; but the Covent Garden opposition failed, and it has been truly said of Garrick that the remainder of his theatrical career was an uninterrupted series of successes that brought enduring prosperity. He had written, while an actor, his farces of 'The Lying Valet'; 'Lethe,' and 'Miss in Her Teens'; and in 1766 he composed, jointly with Colman, the excellent comedy of 'The Clandestine Marriage.' The year 1769 was signalized by the famous Stratford jubilee—a striking proof of his enthusiasm for Shakespeare. It occupied three days at Stratford, and its representation at the theatre lasted for 92 nights. The last part which he performed was Don Felix in 'The Wonder,' for the benefit of the theatrical fund (10 June 1776). At the conclusion of the play he addressed a brief farewell to the audience. The general feeling with which this was delivered and received rendered it truly impressive. His remains were interred in Westminster Abbey, his funeral being attended by a numerous assemblage of rank and talent. As an actor Garrick has rarely been equaled for truth, nature and variety and facility of expression, for which his countenance appears to have been admirably adapted. Expression and the language of passion formed his great strength, as he was equaled by many of his contemporaries in the enunciation of calm sentimental and poetical declamation. His literary talents were respectable, but not eminent; besides the pieces already mentioned he wrote some epigrams, a great number of prologues and epilogues, and a few dramatic interludes, and made many and sometimes judicious alterations of old plays. A collection of his works was published in London (1768–98), and his correspondence 1831–32. Consult Knight, 'Life of David Garrick' (London 1894); Parsons, 'Garrick and his Circle' (Boston 1907).

GARRIGAN, Philip Joseph, American Roman Catholic prelate: b. Cavan, Ireland, 8 Sept. 1840. While he was still very young the family came to America and settled in Massachusetts and in the schools of that State he received his elementary education. He afterward studied at Saint Charles' College, Maryland, later taking an ecclesiastical course at Saint Joseph's Seminary, Troy, N. Y., where on 10 June 1870 he was ordained priest. He was then appointed assistant in Saint John's Church, Worcester, Mass. In 1873 he became vice-president of the Troy Seminary and after three years was recalled to the diocese of Springfield. In 1888 he was chosen vice-rector of the Catholic University, Washington, D. C., and continued to hold the vice-rectorship until 21 March 1902, when Pope Leo XIII selected him for the newly-created episcopal see of Sioux City. He was consecrated bishop at Springfield, Mass., 25 May 1902.

GARRISON, George Pierce, American historical scholar: b. Carrollton, Ga., 19 Dec. 1853. He was educated at Sewanee College, Tennessee, and the universities of Edinburgh and Chicago; became instructor in English and history in the University of Texas in 1884, assistant professor of history in 1888 and professor in 1897. He has published 'The Civil Government of Texas' (1898), etc.

GARRISON, Lindley Miller, American lawyer and cabinet officer: b. Camden, N. J., 28 Nov. 1864. He was educated at the Protestant Episcopal Academy of Philadelphia, at Phillips Exeter Academy and at Harvard University. He studied law in the offices of Redding, Jones and Carson, Philadelphia, and was admitted to the Pennsylvania bar in 1886. In 1888 he was admitted to the New Jersey bar and practised at Camden, N. J., until December 1898, when he became member of the firm of Garrison, McManus and Enright of Jersey City. From 1904 to 1913 he was vice-chancellor of New Jersey. On 5 March 1913 he became Secretary of War in the cabinet of President Wilson. On 10 Feb. 1916 he resigned his cabinet post and has since been a member of the law firm of Hornblower, Miller, Garrison and Potter of New York.

GARRISON, William Lloyd, American reformer: b. in Newburyport, Mass., 12 Dec. 1805; d. New York, 24 May 1879. He was apprenticed to a shoemaker, but eventually became a compositor on the Newburyport *Herald*, an occupation which suited his taste; he soon made himself master of the mechanical part of the business, and when only 16 or 17 began to write for the *Herald*. His contributions, which were anonymous, were favorably received, and he soon commenced to send articles to the Salem *Gazette* and other papers, drawing the attention of political circles by a series of articles under the signature «Aristides,» with the view of removing the almost universal apathy on the subject of slavery. In 1824 he became editor of the *Herald*, and some of Whittier's earliest poems were accepted by him, while their author was yet unknown to fame. In 1827 he became editor of the *National Philanthropist*, the first American temperance journal, and afterward of a journal in support of the election of John Quincy Adams. With Mr. Lundy, a Quaker, he then started at Baltimore the paper called the *Genius of Universal Emancipation* (1829). The vigorous expression of his anti-slavery views in this last paper led to his imprisonment for libel, from which he was released by Mr. Tappan, a New York merchant, who paid his fine. He then prepared a series of emancipation lectures, subsequently delivered in New York and other places. He returned to Boston, and in 1831 started *The Liberator*, without capital or subscribers, a paper published weekly with the aid of one assistant and a negro boy, and with which his name is inseparably associated, and which he carried on for 35 years, until slavery was abolished in the United States. In 1832 appeared his 'Thoughts on African Colonization,' and in the same year he established the American Anti-Slavery Society. For several years the mail brought hundreds of letters to Garrison, threatening his assassination if he did not discontinue *The Liberator*; the legislature of Georgia offered a reward of $5,000 to any one who should prosecute and bring him to conviction in accordance with the laws of that State; in 1835 he was severely handled by a Boston mob, and the mayor of that city was constantly appealed to from the South to suppress his paper. In spite of all, he successfully persevered. In 1833 he visited Great Britain. On his return the results of his conferences with English emancipators were seen, to a limited extent, in a platform for the American Anti-Slavery Society, founded in Philadelphia toward the close of that year. He went to England again, in the furtherance of his anti-slavery opinions, in 1846 and 1848. The diverging views of the anti-slavery party, as to whether a political platform should be adopted, and as to the voting and speaking of women, rent the body for a time, but on 1 Jan. 1863 Lincoln's proclamation of freedom to the slaves as a military measure placed the civil struggle on an anti-slavery basis. In 1865, when Garrison's labors had been completely successful, and after the total abolition of slavery in the United States, his friends presented him with the sum of $30,000 as a memorial of his services.

A bronze statue has been erected to his memory in Boston. Some 'Sonnets and Other Poems' by him were published in 1847, and 'Selections from Writings and Speeches' in 1852. Consult Johnson, 'William Lloyd Garrison' (1882); 'William Lloyd Garrison, the Story of His Life,' by his children (1885–89); and poems to his memory by both Whittier and Lowell. The reformer's character, as revealed in the accounts of his life, shows his great humanitarian schemes to have been the inevitable outcome of a sensitive conscience, a humane spirit and an overpowering sense of justice. Later biographies are those by Swift, L. (Philadelphia 1911), and Chapman, I. J. (New York 1913).

GARROD, Sir Alfred Baring, English physician: b. Ipswich, 1819; d. 1907. He was educated at University College and at the University of London. In 1847 he became assistant physician at the hospital of University College, and four years later became physician and professor of therapeutics there. He became physician to King's College Hospital in 1863 and consulting physician there in 1874. In 1856 he became Fellow of the Royal College of Physicians and two years later of the Royal Society of Great Britain. In 1896 he was nominated physician extraordinary to Queen Victoria. He made original investigations on the pathology of gout and prescribed lithia as a remedy. His 'Essentials of Materia Medica and Therapeutics,' which first appeared in 1885, went through very many editions and is in high favor as a textbook.

GARROTE, ga-rōt', a mode of punishment in Spain by strangulation, the victim being placed on a stool with a post or stake (Spanish, *garrote*) behind, to which is affixed an iron collar with a screw; this collar is made to clasp the neck of the criminal, and drawn tighter by means of the screw till life becomes extinct. This word, with the spelling *garrotte*, has of late years become naturalized in Great Britain and the United States as a term for a species of robbery effected by suddenly springing upon and throttling the victim, and stripping him of his property. A law was passed in 1863 to do away with this practice; and it proved efficient. Consult Andrews, W., 'Bygone Punishments' (London 1899).

GARRUPA, ga-roo'pa, the Spanish name, in the West Indian region adopted as generic, and also corrupted into «grouper» of the great black jewfish (*Garrupa nigrita*). See JEWFISH.

GARSHIN, gär'shēn, **Vsevolod Mikhailovich**, Russian man of letters; b. Yekaterinoslav, 2 Feb. 1855, of an ancient noble family; d. 1888. His childhood was not at all joyous; he was surrounded by unhappiness, his earliest anticipations of life were dark. This state of pessimism in a child was aggravated by his unusual precocity. At the age of seven he read Hugo's 'Notre-Dame de Paris' and his youthful soul was strangely impressed and his only desire was to perish in war. Therefore he tried to join the volunteer corps for Serbia (Serbo-Turkish War 1876), but, not being of military age, he was not allowed to go. When next year, however, Russia declared war on Turkey he threw his examination papers in a gymnasium where he was studying and immediately joined Bolkousi's regiment. In a battle on 11 Aug. 1877 he distinguished himself for bravery, receiving a serious wound in the leg. After the war he studied philology at the University of Saint Petersburg and wrote his war memories under the title 'Four Days,' published in 1877 and attracting immediate attention. But his soul was growing darker and darker and it was difficult for the best psychiatrists to establish in him where the high degree of his soul ended and where insanity began. After long wanderings he went to Yasnaya Polyana where Count Leo Tolstoi received him amiably and spent a whole night with him in a discussion as to "how to make all mankind happy." Partly Tolstoi's powerful logic and partly Garshin's happy marriage contributed to an improvement of the author's mental state, but in 1888 he jumped to death from the fourth floor of a building. The unusually human views on life and the necessity for struggle against evil as expressed in his 'Four Days' are in striking contrast to the author's mad wish for his own death. He considers the extermination of men by men in wars as most hopelessly vulgar and cruel, while he, himself, sought salvation in a war, justifying his action with his desire to free the brother-Serbians from the barbarian Turkish yoke. In his 'Hodozhniki' ("Artists") he, as a very subtle critic and admirer of arts, demonstrates that a moral-sensitive man cannot peacefully abandon himself to the æsthetic enthusiasm of creation in art when he is so cruelly surrounded by the suffering of mankind. His ever-burning wish to exterminate all the evil from the earth and his poetic thoughts about the ideal life have found expression in his remarkable story 'The Red Flower,' which is in some measure the author's autobiography. However, in the depth of his heart and soul Garshin did not believe in the triumph of good over evil, nor that the very annihilation of evil could ever constitute man's complete happiness. His other works 'From the Diary of the Private Ivanov,' 'Attala Princeps,' 'Nadezhda Nikolaevna,' 'Signal,' 'The Proud Aggei,' etc., show manifestly the author's powerful talent and bring home to the reader his passionate humane feeling and the softness and sincerity of his soul.

GARSTANG, John, English archæologist: b. Blackburn, 1876. He was educated at Jesus College, Oxford, where he was graduated in 1899. Since 1897 he has been engaged in archæological research; conducted excavations on Roman sites in Britain at Ribchester, Melandra Castle, Richborough, etc.; in Egypt at Abydos, Mahâsna, Bêt Khallâf, Beni-Hassan, Esna and elsewhere. He conducted an archæological expedition in Asia Minor and North Syria in 1907, and excavations on the Hittite site of Sakje-Geuzi in Asia Minor in 1908 and 1911. He was engaged on the continuous excavation of ancient Meröe from 1909 to 1914, and since February 1915 has been on special service in France. He published 'Short History of Ancient Egypt'; 'The Land of the Hittites' (1911); 'On Lucian's De Dea Syria' (1913), and various reports.

GARTER, Order of the, the highest order of knighthood in England. Two stories are told of its origin. The first is that Richard I at the siege of Acre caused some of his officers to tie leather thongs around their legs as a distinction. The origin of the order is, however, generally attributed to Edward III, and the legend runs that the Countess of Salisbury having dropped her garter while dancing, the king restored it after putting it round his own leg, amid the jesting of courtiers, with the words, *Honi soit qui mal y pense* —"Shame be to him who thinks evil of it." The date of the foundation or restoration by Edward III of the order is not exactly determined; 1344 is given by Froissart, while other authorities, founding on the statutes of the order, assign it to 1350. In the former year it appears that a festival was held, and a society or company instituted, called the Company of Saint George, with the design of furnishing soldiers of fortune to assist King Edward in asserting his claim to the crown of France, but it seems probable that the organization was completed as an order of chivalry in 1350. The order is said to have been founded in honor of the Holy Trinity, the Virgin Mary, Saint Edward the Confessor and Saint George of Cappadocia, the last being its special patron. Until the reign of Edward VI its common title was the Order of Saint George, which it still bears, beside that of the Garter. The original number of knights, 26, including the sovereign, its permanent head, is still retained, except that since 1786 princes of the blood are admitted as supernumerary members. The order is frequently conferred on foreign sovereigns. The vestures and insignia of the order are: The emblem of the order, the garter, a dark-blue ribbon edged with gold, bearing the motto, and with a buckle and pendant of gold richly chased; worn on the left leg below the knee; the mantle of blue velvet, the length of the train distinguishing the king; the surcoat and hood of crimson velvet, the hat of black velvet, with plume of white ostrich feathers, having in the centre a tuft of black heron's feathers, and fastened to the hat with a band of diamonds; the collar of gold consisting of 26 pieces, each in the form of a garter, with the badge of the order, called the George, pendent from it — a figure of Saint George on horse-back fighting the dragon — the lesser George being worn on a broad blue ribbon over the left shoulder. The star, formerly only a cross, is of silver, and consists of eight points, with the cross of Saint George in the centre, encircled by the garter. A star is worn by the knights on the left side when not in the dress of the order. The officers of the order are the prelate, the bishop of Winchester; the chancellor, the bishop of Oxford; the registrar, dean of Windsor; the garter king-of-arms, and the usher of the black rod. There are a dean and 12 canons, and each knight has a knight-pensioner.

GARTER KING-OF-ARMS, the head of the heraldic establishment in England, consisting of three kings-of-arms — Garter, Clarencieux and Norroy, and the herald of the military order of the Garter. The office of garter king-of-arms was instituted by Henry V in 1417. The duties of the garter king-of-arms are principally to grant heraldic supporters, to arrange funerals and to present the order of the Garter to foreign princes. The Garter is a member of the Heralds' College.

GARTER-SNAKE, or **GRASS-SNAKE.** Names given in the United States to several small striped harmless serpents of the genus *Eutænia*, especially *E. sirtalis*, which abounds in all temperate parts of the continent from Guatemala to Canada, and is exceedingly variable.

This species varies in color from light-green through olivaceous to black, marked by three stripes, but only the one along the spine is well defined, those on the sides being often obscure, broken or altogether absent. The spaces between these may be spotted in double rows, or not at all; and the belly, usually light greenish-blue, may be darker, almost to blackness. Some varieties have a metallic lustre. The ordinary eastern specimens are olive-brown, with dull spots and stripes. It is everywhere abundant, frequenting grassy meadows, farm-fields, roadsides and gardens, where it searches for mice as the principal part of its food, but it eats insects, small toads and frogs, and the eggs and young of birds whose nests are on or near the ground, for it is not a bold climber. It is abroad by day as well as by night, and itself forms the prey of such larger snakes as the blacksnake and king-snake. In the West it eats all the young gophers and ground-squirrels it can get, and in these habits commends itself to the protection of agriculturists. These snakes are extremely active and swift, as they must be not only to capture their prey, but to avoid being caught by the larger blacksnakes, king-snakes and the like which pursue them. They swim well and hide clearly in water, and in many habits, as in structure, resemble the water-snakes (*Natrix*); and like them they are pugnacious, and quick to bite when handled, but their teeth are minute and the bite, of course, quite harmless. Their abundance is due to these qualities, not only, but even more to their great fecundity, 25 to 40 young in a season not being an uncommon product for one mother, and an instance of 80 is recorded. These are born alive, in early warm weather, and are able to care for themselves from the start, but the mother remains near them and protects them vigorously for some time. When cold weather approaches, these serpents seek underground retreats, such as old gopher-holes, and there often gather in large numbers which hibernate entwined together in a mass; mating takes place at this season. The skin is usually shed in the spring, by creeping through some crevice and scraping off the old hide, which peels backward from the head.

Of the score or more of species the greater number are Mexican and Central American; and some are known by very few specimens. The beautiful slender ribbon-snake (*E. saurita*) of the Southern States is chocolate in color, with three narrow distinct stripes, and has highly aquatic habits. The common species of the plains region (*E. radix*) is peculiar in its fondness for fish, catching them constantly in the pools and seizing every dead one cast on shore. A similar fish-loving species is the subtropical *E. macrostemma,* which appears in the talons of the eagle in the coat of arms of Mexico. The common species of California is *E. elegans.* In the southern part of that State occurs a rare form (*E. infernalis*), sometimes wholly black, save a yellowish throat. For the identification of the various species of this wholly American group the reader should consult Cope's 'Crocodilians, Lizards, and Snakes of North America,' published by the Smithsonian Institute in 1900.

GARVEY, Eugene A., American Roman Catholic bishop: b. Carbondale, Pa., 6 Oct. 1845. He attended Saint Charles' College, Ellicott City, Md., and was graduated in theology from Saint Charles' Seminary, Philadelphia, Pa. He was ordained priest, and was assistant pastor at Hawley, Pa., 1870; pastor at Athens, Pa., 1871; Williamsport, Pa., 1871–99, and at Pittston, Pa., 1899–1901; when he was elected bishop of Altoona, Pa., and was consecrated 8 Sept. 1901.

GARVIE, Alfred Ernest, British Congregational clergymen: b. Zyrardow, Russian Poland, 1861. He was the son of a Scottish flax merchant, and received his education at George Watson's College, Edinburgh, Glasgow University and Oxford. In 1893 he was called to Macduff Congregational Church, and later to Montrose Congregational Church. From 1903–07 he was engaged in educational work as professor at Hackney and New colleges, and later as principal of the latter institution. He was elected president of the Congregational Union of Scotland in 1902. His publications include 'Ethics of Temperament' (1895); 'Ritschlian Theology' (1899); 'The Gospel for To-day' (1904); 'Religious Education' (1906); 'Studies in the Inner Life of Jesus' (1908); 'Handbook of Christian Apologetics' (1913). He also wrote commentaries on Romans and Saint Luke, and edited the 'Westminster New Testament.'

GARY, Elbert Henry, American financier: b. Wheaton, Ill., 8 Oct. 1846. He was graduated at the law school of Chicago University in 1867; admitted to the bar of the Illinois Supreme Court the same year, and to that of the United States Supreme Court in 1882. After serving as first mayor of the city of Wheaton for three terms, and as county judge of Dupage County for two terms, he applied himself to the practice of corporation law in Chicago, and became general counsel for a large number of railroad and industrial corporations. It was largely through his legal work that his talents as an organizer of large industries first came into recognition. He retired from law practice in 1898 to become president of the Federal Steel Company, which in 1901 was merged into the United States Steel Corporation, he then being chosen chairman of its finance committee, to which office was added that of chairman of the board of directors. The city of Gary, Ind., which the United States Steel Corporation built at the foot of Lake Michigan, a few miles out of Chicago, was named after him.

GARY, Lake County, Ind., the seat of the largest steel industry in the United States, and the largest as well as youngest city in the northwestern part of the State, is situated at the extreme southern end of Lake Michigan, 10 miles east of the Indiana-Illinois State line, 26 miles southeast of the heart of Chicago and 163 miles northwest of Indianapolis. The city of Gary was founded in April 1906, when the site was an almost impenetrable wilderness of swamps and sand dunes. The population in 1910, according to the Federal census, was 16,802; in 1916, 40,000. The city limits embrace a territory extending along the shore of Lake Michigan a distance of seven miles and extending inland a distance of five and three-fourths miles. The general elevation of the site occupied by the city is 30 feet above the lake, the entire site being covered with a layer of fine sand to a depth of 80 feet, once forming the bed of Lake Michigan when that body of water extended four miles south of the present shore line. The site of the city is traversed from east to west by two rivers, the Grand and Little Calumet, both of them susceptible of being converted into vast inner lake harbors, having 28 miles of water frontage. Gary has 70 miles of improved streets, 100 miles of cement sidewalks, 60 miles of main and lateral sewers, 34 miles of electric street railway tracks, two interurban railway lines passing through the city, two other interurban lines entering the city and making it their terminus, with a total of 455 miles of tracks, seven trunk lines of steam railroads and two belt and terminal lines connecting the city directly with the 32 trunk line railroads entering the Chicago-Gary region. In addition there is a splendid harbor accommodating the largest ore vessels on the Great Lakes, constructed by the Indiana Steel Company—(a subsidiary of the United States Steel Corporation) and used in conveying iron ores from the northern mines to the Gary furnaces and in carrying the steel and coke output of vast local industries to all parts of the United States and Canada reached by water transportation.

Equipment.— In 1916 the city of Gary possessed seven banks with an aggregate capital of $575,000; surplus, $139,500; deposits, $4,230,000, 24 churches, three hospitals, a Young Men's Christian Association building costing $250,000, a public library building costing $65,000, two of the finest and largest public school buildings in the Middle West, aggregating in cost $475,000, three other schoolhouses costing $150,000. Broadway, Fifth avenue and Washington street, the principal business streets of the city, are lined with handsome business blocks, Gary Theatre, banks, hotels and public buildings, while the residence streets and avenues are graced with hundreds of handsome homes and beautiful churches and schools, both public and parochial. The city is splendidly equipped with auto patrol and fire engines used by the metropolitan police force and the fire department of the city. Water for domestic purposes and drinking is drawn from Lake Michigan in inexhaustible quantities, while all other public utilities, such as gas, electric lights, and telephone service, are adequate for a city of 250,000 inhabitants.

Expenditures.— Gary was founded by the United States Steel Corporation, which, up to 31 Dec. 1916, had expended $85,000,000 in building steel furnaces, coke ovens, rail mills, axle mills, merchant mills, sheet and tin plate plants, structural steel works, pumping stations, electrical power plants, benzol works, Portland cement works, ore docks, machine shops and foundries and a corporation hospital, which, when fully equipped, cost nearly half a million dollars. In addition to this expenditure, the corporation, through its subsidiary concerns, expended in five years the sum of $15,000,000 on the improvement of the city and in constructing homes for its officials and employees. A further appropriation of $40,000,000 has been made by the steel corporation for extensions and improvements of its various local plants.

Industries of Gary.— In the year 1916 the various plants of the steel corporation and its subsidiary companies are giving employment to 18,000 men. When fully completed, these plants are capable of giving employment to 40,000 men. The Gary Bolt and Screw Works, an independent industry, began operations in 1912, giving employment to 1,000 persons at the start and has since greatly extended its operations. In the spring of 1912 the Baldwin Locomotive Company purchased a site adjacent to the city limits on the west. Other independent industries and fabricating plants are locating in Gary. During the first six years of its existence, the supply of houses in Gary for mill employees fell far short of the demand and thousands of the mill workers were forced to live in surrounding towns and cities. In 1911 nearly 1,000 homes were erected and more than 1,500 dwellings were planned for erection in 1912. The principal commercial artery of the city — Broadway — is 100 feet wide and five miles long. Fifth avenue, the principal east and west thoroughfare, is 80 feet wide and seven miles long. Both of these streets are improved their entire length. Within a radius of 10 miles from the intersection of Broadway and Fifth avenue there is a population of 120,000 people, largely supported by the manufacturing industries of the famous Calumet region, of which the city of Gary is the centre. The steel, cement, sheet and tinplate and coke oven industries of the city occupy seven miles of the lake front and also several miles of water front upon the Grand Calumet River, which the Federal government plans to convert into a great inner harbor, connecting with Lake Michigan at Gary, Indiana Harbor and South Chicago. The largest manufactory of Portland cement in the world, the Universal Portland Cement plant, with a daily capacity of 27,000 barrels and employing 2,500 men, is situated at Buffington, within the city limits of Gary, and is one of the subsidiary interests of the United States Steel Corporation. In the southern part of the city is located the Fairweight Scale plant, employing 500 men and covering nearly 20 acres of ground with its buildings and yards. The city hall, at the corner of Seventh avenue and Massachusetts street, would be a credit to a city of 250,000, while the new union station at Third avenue and Broadway, costing $250,000, is adequate to the comfort and needs of a city of 500,000 population. Although the city of Gary was only 10 years old in 1916 the assessed valuation of real estate aggregated a total of $28,000,000. The city of Gary through its park board has established a boulevard system, and has started condemnation proceedings for a park on the lake front. This will add very much indeed to the desirability of Gary as a residence city. The speeding-up of the steel and ancillary industries for war purposes brought about increased prosperity to Gary and added thousands to its population.

GAS. See Critical Point; Gases, Kinetic Theory of; Gasometric Analysis; Liquefied Gases.

GAS, Natural. By recognized usage the term «natural gas» has been restricted to the inflammable gases found accumulated in reservoirs in the earth's crust — leaving the equally natural supplies of carbonic acid gas and of nitrogen to be given a more specific title. In composition, various samples of natural gas differ very considerably, but its principal component is methane, or marsh gas (CH_4), ranging from 81 per cent for Pennsylvania and West Virginia gas to 98 per cent in some of the gas produced in Oklahoma. In the Glenn Pool (Oklahoma) gas, known as "wet" gas from its heavy content of petroleum vapors, the components are methane, 39 per cent, and ethane, 61 per cent. The gas at Dexter, Kan., has but 15 per cent methane, and 83 per cent nitrogen. The combustion factor of the Pennsylvania and West Virginia gas is made up by 14 per cent of other hydrocarbons, chiefly ethane, and hydrogen. In addition, natural gas contains from 2 to 5 per cent nitrogen; up to 2 per cent of carbonic acid; up to ½ of 1 per cent of carbonic oxide and up to ½ of 1 per cent of oxygen. Occasionally small quantities of helium are present; in one case 1.84 per cent. It has an average heating value of about 945 British thermal units per cubic foot at a pressure of four ounces per square foot, and a temperature of 60° F. At a greater pressure and at a higher temperature its heating value is increased by about one unit for each higher degree of temperature, and two units for each added pound of pressure.

The accompanying table presents a comparison of the principal types of natural gas with the other economic artificial illuminating and fuel gases.

ever there are hollows in which the pressure is less than its own, and only collects in considerable quantities where there is an impermeable stratum of clay or rock to prevent further movement. In these hollows it accumulates under varying pressures, depending upon their depth below the surface, the pressure having a close relation to the weight per square inch of a column of water of the same height; from which it is argued that the pressure found in natural gas reservoirs is derived from water forcing the gas out of a lower level. The maximum pressures reported have been 1,700 pounds per square inch in Green County, Pa., and 1,260 pounds more recently at Midway, Cal.

Wells and Conditions of Strata.— There is a great variation in the depth of natural gas wells, owing to the diversity of the strata in which the product exists and the changing position of the underlying rocks with reference to the general surface. Some natural vents have produced natural gas in considerable quantities and have proved the incentive for drilling down to the original reservoirs, from which the gaseous fluid was escaping. Other gas wells have been discovered in drilling wells for oil or salt brine. Some of the most important gas fields have been located by expert geologists, who have traced out the summits of the anticlinals, or rock waves, for many miles from surface exposures of the strata.

Constituents	Average for Penna. and W. Virginia	Average for Ohio and Indiana	Average for New York	Average of Coal Gas	Average of Water Gas	Average of Producer Gas from Bit. Coal
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Marsh gas (CH_4)	80.85	93.60	98.40	40.00	2.00	2.05
Other hydrocarbons	14.00	.30	0.25	4.00	.00	.04
Nitrogen	4.60	3.60	0.40	2.05	2.00	56.26
Carbonic acid, CO_2	.05	.20	.00	.45	4.00	2.60
Carbonic oxide, CO	.40	.50	0.95	6.00	45.50	27.00
Hydrogen	.10	1.50	.00	46.00	45.00	12.00
Hydrogen sulphide	.00	.15	.00	.00	.00	.00
Oxygen	Trace	.15	.00	1.50	1.50	.05
Total	100.00	100.00	100.00	100.00	100.00	100.00
Pounds in (a) 1,000 cubic ft.	47.50	48.50	49.10	33.10	45.67	75.00
Specific gravity, air being 1	0.624	0.637	0.645	0.435	0.600	0.985
B. T. U. per 1,000 (b) cubic feet	1,145,000	1,095,000	1,300,000	755,000	350,000	155,000

(a) 1,000 cubic feet of dry air at an atmospheric pressure of 14.7 pounds and at a temperature of 60° F. weighs 76.12 pounds and is a mechanical mixture of 23 parts of oxygen and 77 parts of nitrogen by weight.
(b) B. T. U. = British thermal units, which indicate the heat necessary to raise 1 pound of pure water at 39° F. one degree.

Natural gas is regarded as a form of bitumen, closely related to petroleum, maltha and asphalt. It may be mentioned in passing that the asphalt which is continually rising on the lake at Trinidad is aërated by large bubbles of natural gas. Opinion is divided as to the origin of natural gas, but the majority favors the theory that it is the product of vegetable matter slowly decaying at a low temperature. As it is found only in sedimentary rocks, the theory prevails that it is the product of carbonaceous matter deposited with those strata, although it is quite as likely to have been formed elsewhere, finding its way into those rocks because of their porous structure. Gas, because of its natural qualities, has a tendency to make its way for long distances wher-

The depth of wells varies from 250 to 3,000 feet, while their diameter varies from two inches up to eight inches; their output, or open flow, varies from 500 cubic feet per day to 35,000,000 cubic feet per day; their shut in, or rock pressure, varies from 1 to 1,500 pounds to the square inch in extreme cases, while 300 to 400 pounds to the square inch and a volume of 1,000,000 cubic feet per day is considered a profitable commercial well. The greatest yield on record for any one well is 7,781,946,000 cubic feet in 7½ years, an average of 2,842,700 cubic feet per day for the entire period. This well is in Pennsylvania. It is down 3,000 feet tapping the Gordon sand. In 1915 it was still yielding 1,000,000 cubic feet per day. In many of the deeper wells, two or more reservoirs of natural gas are often found. The cost varies from a few hundred dollars in the shallow shale districts to $10,000 in the deep wells in West Virginia. All large wells are usually tubed and a packer set just above the gas sand; the top of the tubing is held by clamps attached to bolts that are anchored and a heavy gate valve attached, so that the well can be shut in and the gas held in the rock when not in use.

The reservoirs in which natural gas is usually found stored when pierced by the drill are composed of porous sandstone or limestone. In some cases a limited quantity of the gas has been found in shales but this gas may be regarded as having gradually accumulated from the underlying rock formation. Almost invariably the large reservoirs have been developed in the strata on or near the crests of the anticlinal or rock waves, while petroleum has been generally collected on the lower horizon; and frequently salt water is found at a still lower level. Sometimes, however, the gas fields are entirely isolated from the petroleum producing areas. There are three leading requisites necessary for the accumulation of natural gas in merchantable quantity. These are as follows:

1. An open or porous strata capable of storing the gas under pressure, generally sandstone or limestone.

2. A slate or shale covering of this porous strata to seal in the upper surface and the fractures of the strata saturated with natural gas.

3. A sufficient flexure or relief of the strata to enable the separation of the salt water and the petroleum from the natural gas, which is almost invariably found in the higher portion of the strata.

These gas reservoirs have been accumulating for ages the gas they contain.

Original Pressure.— The original pressure of natural gas reservoirs has been found in many cases equal to the hydrostatic balance, or, in other words, to the weight of a column of water equal to the vertical distance between the reservoir and the surface of the ground. Allowing 2.3 feet for each pound, or about 43 pounds to the 100 feet, a reservoir at a depth of 1,000 feet should show 430 pounds rock pressure per square inch. This hydrostatic pressure has been equalized to a certain extent by a large number of minute vents that have permitted the escape of the lighter hydrocarbons to the surface. These vents are of common occurrence throughout the Appalachian gas field from northwestern central New York to central Tennessee and along the great Cincinnati uplift from central Kentucky to northern Ontario.

These vents have during past ages allowed the gas to escape in immense quantities, amounting to unnumbered millions of cubic feet, so that the supplies from which we are now drawing are presumably but a small fraction of what has been produced in the earth.

Reserves of Natural Gas.— Many of the original natural gas fields have been practically exhausted and a large number of the producing companies have had to seek new localities, where a fresh supply could be secured. This has been often accomplished by drilling deeper wells in more remote regions. The gas fields adjacent to Pittsburgh having been used up, most of the supply for that city now comes from the deep natural gas sands of southwestern Pennsylvania and West Virginia, distant from 80 to 100 miles. The gas pressure in the original pool in northwestern Ohio is nearly exhausted. That of central Indiana has only about 15 per cent of the original pressure and volume remaining. The newly developed field in eastern central Ohio has recently supplied a large and increasing quantity to the inhabitants of that State. West Virginia has, during recent years, supplied a constantly increasing quantity of natural gas to Ohio and Pennsylvania. New York and Ohio have also been supplied by Pennsylvania. In all the natural gas fields it requires constant drilling of new wells and their connection with the main lines to keep up the supply, which is continually being depleted. Owing to the decrease in pressure at the wells and the desire to deliver large quantities of natural gas to distant consumers without increasing the size of the main lines, the companies have erected powerful compressing plants in convenient localities. These plants are models of mechanical engineering skill. The compressors are, in many cases, operated by large internal combustion engines of from 500 to 1,500 horse power each. About nine cubic feet only of natural gas is required to develop one horse power; and 1,000 cubic feet of natural gas at a pressure of 0 may be compressed to 270 pounds, by consuming 33⅓ cubic feet (or 3⅓ per cent), where very close to double this quantity is required if the natural gas be consumed under boilers and the steam used in condensing engines. The deep sand reservoirs in southwestern and central Pennsylvania and those of West Virginia should keep up a fair supply for many years to come. The West Virginia field is estimated as good for 50 years at its present rate of utilization. What may result from the deeper drilling of wells in localities where structural conditions are favorable is a problem for future determination. The Caddo field of Louisiana is regarded as the most extensive and prolific of all. Its utilization was begun only in 1913. The California field, developed in 1910, has not yet reached its maximum.

Occurrence, Geological Horizons, etc.— In the United States the principal sources of natural gas are located on the west slope of the great Appalachian uplift, extending from New York through Pennsylvania and West Virginia to southern central Kentucky, with a considerable portion of southeastern Ohio, also along the northern portion of the great Cincinnati uplift in northwestern Ohio and central Indiana and southeastern Kansas. There has been recently developed an important natural gas field in eastern central Ohio.

In California, Texas, Louisiana, Colorado, South Dakota and Alaska gas is found in geologically more recent rocks, but no attempt is here made to correlate the rocks of one field with those of another. In the Mississippi Valley to the eastward natural gas occurs almost universally in rocks of Palæozoic Age, extending from the highest Carboniferous down at least as far as the Trenton limestone, a distance of over 9,000 feet. The rocks vary greatly in thickness from place to place, so that no one section can be regarded as typical of all parts of the region. The 50 gas-bearing horizons known are composed of very different material, ranging from the coarser sandstones of the Upper Carboniferous and Catskill period to the finer sands of the Middle and Lower Devonian, the limy sands of the Silurian period, the crystalline limestones of the Ordovician and the crystalline sands of the Cambrian period.

So far as at present discovered there are five great gas fields in the United States, the Pennsylvania and West Virginia field; the Kansas field; the Oklahoma field; the Louisiana field and the California field. During 1915 two wells in Montana flowing 6,000,000 cubic feet per day were opened, and there have been promising developments in new grounds in Indiana, Kentucky, Oklahoma and Louisiana. There were, in 1915, 23 States in which some natural gas was produced, though the yield was notably large only in nine. In all, the gas-yielding territory of the United States covers about 9,365 square miles, of which some 10,600,000 acres are being actively exploited by gas producers. The States that produce large quantities of natural gas, as Pennsylvania and West Virginia, distribute it to the adjoining States by a system of pipe lines, so that in some instances the natural gas consumed in a town or city is produced over 200 miles from where it is consumed. Thus Oklahoma and Kansas pipe gas into Missouri; Louisiana into Arkansas and Texas; Illinois into Indiana and Oklahoma into Arkansas.

In many localities the yield of gas is incidental to the production of petroleum, and the former has been frequently sacrificed for the more stable fuel. This is the case particularly in the Caddo field of Louisiana, where billions of feet of gas have been allowed to escape unhindered. For some years open gas vents known as «roarers» were of interest only as a night spectacle when, having been ignited, their flames, a hundred feet in height, lighted up the surrounding country. It is a satisfaction to record that in most localities this waste has been checked. Another avenue of serious waste, when the totals are considered, is that which has occurred in boring for oil. This, too, has been overcome by sealing the gas sands with clayey mud, when they are encountered in the search for oil.

Production of Natural Gas in the United States.— No other country enjoys the luxury of natural gas to the extent of the people of the United States. It is used in Canada and in a very limited way in England, Australia, Germany, Rumania, Galicia, Russia, Persia, India, China and Japan, but all these countries combined use only 2 per cent of the known world's commercial production of this efficient and convenient fuel, leaving 98 per cent to be consumed by the people of the United States. The total value of the natural gas produced and sold since its introduction, commercially, in the United States, in 1872, up to the close of 1915 was $1,164,717,474. Assuming the average price of the last 25 years, 12 cents per 1,000 cubic feet, this value should represent 9,705,978,950,000 cubic feet in amount. If it were possible to confine this immense quantity in a tank whose end was one square mile in area it would require to be 630 miles in length. Its heating value would equal 945,000,000 tons of coal. Large as this quantity seems, it is quite probable that it does not represent one-half of the actual quantity which has flowed from the earth's rocky reservoirs since the discovery of petroleum. The loss in developing petroleum fields has been so great that these figures, representing only that amount of gas which has been collected and sold on a commercial basis, give little idea of the actual evolution from the great gas reservoirs.

The volume of natural gas utilized in the United States in 1916 was greater by nearly 20 per cent than the record production of the preceding year. Owing, however, to a reduction in the service price in some of the Western and Southern States, there was a slightly lower ratio (18.6 per cent) of increase in the value of the product. The yield amounted to 753,170,253,000 cubic feet (628,578,842,000 cubic feet in 1915), and the value to $120,227,468 ($101,312,381 in 1915). This sum may be better comprehended in its true relation to the mineral wealth of the country, if it is recalled that it is $27,000,000 greater than the value of all the gold produced in the United States in the same year.

Among the several States, the largest producer was West Virginia, with 299,318,907,000 cubic feet; followed in order by Pennsylvania, with 129,925,150,000 cubic feet; Oklahoma, with 123,517,385,000 cubic feet; and Ohio, with 69,888,070,000 cubic feet. Louisiana, Kansas and California each recorded a production of about 32,000,000,000 cubic feet. Nearly two-thirds of West Virginia's production was piped into other States for utilization; and Oklahoma disposed of one-third of its yield in the same way. Pennsylvania, Ohio and Kansas bought practically all of this surplus, and New York bought a considerable share of Pennsylvania's output.

The gas was produced by 7,697 operators, from 37,989 active wells; 3,889 new wells having been added during the year to the 36,546 in production at the beginning of 1916, and 2,446 having been abandoned as no longer profitable. The area under control of the natural-gas producers in 1916 totaled 12,899,781 acres; an increase of 2,252,239 acres in the year.

Consumption and Cost.— The natural gas output of 1915 was consumed by 7,939 manufactories, 10,419 other industrial plants and 2,195,081 domestic consumers; the latter class consuming about 35 per cent of the total. The price to the manufacturers averaged 10.35 cents per 1,000 cubic feet. To the industrial plants it averaged 8.32 per 1,000 cubic feet; and to the domestic consumer, 28.32 cents per 1,000 feet. The prices which are thus expressed in an average figure varied from limits of 8.47 cents per 1,000 feet in Louisiana to $1.00 per 1,000 feet in Iowa; and some industrial plants in West Virginia using large quantities were supplied at the price of 5.41 cents per 1,000 feet.

The above separation of «manufacturing» from other industrial plants depends upon whether the gas is burned directly as fuel, as in the latter, or is used to produce power (steam or electric or gas engine), as in the former. About two-thirds of the 65 per cent used industrially was burned directly as fuel.

As used in the home, natural gas in itself is not dangerous to health. Tests made with canary birds, most delicately sensitive to poisonous gases, showed that they breathed as large a proportion as 34 per cent in the air of a room without showing the least disturbance. They became drowsy when the percentage reached 49 per cent, but did not collapse until it was as high as 66 per cent; and then quickly revived when taken to the outer air. The risk from fire is less than when wood and coal are used. There have been some cases of asphyxiation when a stove has been burned in a room without connection with the chimney flue, as it has been found that under these conditions the air in the room becomes more and more saturated with carbonic acid and the vapors of water and depleted of oxygen. When this vitiated air passes again into the stove the combustion is imperfect, the result being the formation of poisonous carbon monoxide (CO). There is more or less danger also from explosion in the case of a mixture of natural gas with air from a leaky stove. A comparatively small percentage of gas makes an explosive mixture, the limits being 5 per cent (low) and 11.5 per cent (high).

Products of Combustion.— The products of complete combustion of natural gas are water and carbonic acid, slightly over two cubic feet of the former in the form of water vapor and about one foot of carbonic acid gas for each cubic foot of natural gas consumed; both are invisible and nearly odorless. Somewhat more than two cubic feet of oxygen are necessary, but, owing to the air being composed of a larger percentage of nitrogen, a little over 10 cubic feet of air is required for thorough combustion.

It has been found that in a stove without a flue connection, especially if the air in the room becomes more or less saturated with carbonic acid and the vapor of water from lack of fresh air, there is a small percentage of carbon monoxide (q.v.) produced, which is a deadly and insidious poison, and if breathed by a man or an animal will soon cause death, even when a comparatively small percentage is present. When a small stovepipe connecting with a flue is used, no carbon monoxide is formed in the room, the greater portion of the products of combustion being carried outside as the fresh air is drawn in to supply their place. On the other hand, where there is no flue connection or large opening for the free entrance of an abundance of fresh air, a number of fatal results and narrow escapes from asphyxiation have occurred.

Carbon monoxide does not usually exist to such an extent in the natural gas produced in West Virginia or Pennsylvania as is found elsewhere. Analysis shows its presence in the natural gas produced in the Lima-Indiana field to the average extent of about one-half of 1 per cent, and to the average extent of 1 per cent in the natural gas produced in Kansas. Formaldehyde is in some cases formed upon putting the cold surface of a teapot in contact with the gas flame of a stove, or when the flame impinges on the cold sheets of a steam boiler. Its presence in small quantities is made known by its pungent and irritating effect upon the nostrils and throat. The effect is dangerous, yet there are no cases known in which death has resulted from this gas thus generated.

Illuminating Properties.— The illuminating properties of natural gas vary in different localities, because of the difference in the percentage of the heavier hydrocarbon, ethane (C_2H_6). All the natural gas found adjacent to petroleum fields has a larger proportion of ethane than the gas farther removed, and therefore the candle power is considered greater. Ordinary natural gas, if consumed with a common tip at the rate of 7 or 8 cubic feet per hour, will yield about 6 or 7 candle power. In an ordinary Argand burner with chimney, it will give about 12 candle power in consuming 5 to 6 cubic feet per hour. When natural gas is consumed in contact with a mantle of alkaline earth (thoria, etc.), the result is the cheapest and best illuminant known.

Calorific Value.— The calorific or fuel value of natural gas varies in different localities, as the amounts of carbon and hydrogen vary. Those natural gases which contain the highest percentage of carbon give the best results. The standard used in measuring fuel values is called the British thermal unit, written B. T. U., and is the amount of heat necessary to raise the temperature of one pound of pure water 1° F. at or near 39° F., which is the temperature of the maximum density of water. As tested by this standard various samples of natural gas showed heat values ranging from 740 to 1,312 B. T. U. per cubic foot. The quantity of air necessary for the perfect combustion of natural gas varies from 10.4 to 10.8 parts of air to 1 part of natural gas. A number of tests have fully demonstrated that when ordinary care is taken in burning natural gas under boilers in actual service, 1 cubic foot of natural gas will do work equivalent to the evaporation of 1 pound of water from and at 212° F. Since 20 cubic feet of ordinary natural gas weigh 1 pound, 1 pound of natural gas will evaporate 20 pounds of water, while, under similar conditions, 1 pound of petroleum will evaporate only 16 pounds of water, and 1 pound of good coal will evaporate but 10 pounds of water; therefore 10 cubic feet of natural gas or one-half a pound is equal to one pound of good coal. In fact in a number of tests with a Klein or a Kirkwood burner, .87 cubic foot of natural gas has evaporated 1 pound of water from and at 212° F., which will make 17,400 cubic feet equal to one ton of good coal. The actual heating effect of natural gas as a fuel approaches much nearer the theoretical result than can be attained with coal. The price paid by the domestic consumer for natural gas varies in localities, ranging from 13 to 27 cents per 1,000 cubic feet. The consumers near the supply pay less than those farther off. Manufacturers pay less, ranging from 6 to 18 cents per 1,000 cubic feet. About 20,000 cubic feet of natural gas will equal one ton of good bituminous or anthracite coal. If we assume the average price to the domestic consumer to be 22 cents per 1,000, then $4.40 worth of gas will produce the same heating effect as one ton of good coal delivered in the bins — to which must be added the expense of shoveling it into the furnace and the removal of the ashes, as well as the inconvenience of the necessary dust and dirt which invariably accompanies a coal fire.

The Natural Gas Engine.— Natural gas, as applied to the internal combustion engine, has caused a complete revolution in the methods of securing power throughout the gas belt. It has in nearly all instances superseded any other source of power in pumping petroleum wells, In some instances this has been done by substituting a gas cylinder for the steam cylinder, using the same engine bed. The economy in the use of natural gas and the dispensing with the costly and troublesome boiler, with its constant attendant, has brought it into great favor for all sources of power, from a 1 horse-power up to 1,500 horse-power engine.

The following table gives the equivalents of natural gas and coal for both the gas and steam engine per indicated horse power per hour:

Type of Engine	Gas	Coal
	Cubic feet	*Pounds*
Large natural-gas engine, highest type	9	0.9
Ordinary natural-gas engine	13	1.3
Triple expansion condensing steam engine	16	1.6
Double expansion condensing steam engine	20	2.0
Single cylinder and cut-off steam engine	40	4.0
Ordinary high pressure, without cut-off, steam engine	80	8.0
Ordinary oil well pumping steam engine	130	13.0

Uses.— Natural gas is used in domestic service principally as a source of heat and light. It is employed extensively in industrial establishments for many purposes, notably in the generation of steam; in the manufacture of glass; puddling of iron; in roasting ores; in heating furnaces, for lacquering and japanning, annealing and reheating, case hardening, tool tempering, preheating castings in oxy-acetylene welding; and for heating china kilns, water stills, fire expanders, etc.; and in the manufacture of steel and pottery; it is also utilized as a source of power in the gas engine, used in drilling and operating oil and gas wells and in pumping oil, and as a general source of power for all purposes. The heat value stored in natural gas is greater than that caused by any artificial combination of carbon and hydrogen, and it is a perfect fuel as it issues from its original rock-sealed reservoirs. No preparation is necessary for its combustion and no residue is left. It is not affected by ordinary temperature and it is easily distributed by pipes to points of consumption. It is a most economical source of light and power, and an ideal household fuel. Carbon black (q.v.) is the only commercial article that is made directly from natural gas.

Since 1911 a considerable industry has been built up in the production of gasoline from casing-head gas — that is the gas which comes up between the casing and the tubing of an oil well, and collects in the casing head. This gas is known as «wet» gas, carrying a proportion of the vapor of petroleum. The process is also applied to gas from gas wells if it carries as much as six pints of gasoline vapor to the 1,000 cubic feet. For the wetter gases the principle of compression is employed, with subsequent condensation. For the dryer gases the process is to pass the gas through a tank of heavy oil which absorbs the gasoline vapor, and the gasoline is afterward distilled out. In 1915 there were in the United States 414 plants devoted to the production of gasoline from natural gas. The total recovery was 65,364,665 gallons, nearly half of which was gained in Oklahoma. The highest percentage was secured from the gas of the Glenn Pool in Oklahoma, which yielded eight gallons of gasoline per 1,000 cubic feet.

Liquid Natural Gas.— Natural gas may be liquefied by a pressure of 415 pounds at a temperature of 36° F., or a pressure of 506 pounds at 48° F. Fifty cubic feet of the gas condense to one gallon of the liquid gas. The internal pressure in a cylinder of this liquid gas at 133° F. is but 755 pounds per square inch — only one-third the pressure of many liquefied gases. As an illuminant the vaporized liquid gas burns with a slightly yellower flame than the ordinary natural gas, and gives the best results with an inverted Welsbach mantle. It is entirely effective in heating if a plentiful supply of air is provided. With oxygen in a blowpipe it gives a very hot flame. It has been used successfully to run an automobile, where provision is made to keep the valve warm; the vaporing of the liquid gas produces a low temperature in which the unprotected valve quickly freezes up.

Early History.—Natural gas has been known since the earliest records of the human race as a curiosity. Perhaps the first historical record of the use of natural gas is that of the Apollo Oracle at Delphi in Greece, about 1,000 years before the Christian era. The Chinese are credited with the earliest practical application of this fuel at the wells at Tz-Lin-Ching, western China, in the evaporation of salt brine.

The fire worshippers on the shores and islands of the Caspian Sea, in the Baku region, Russia, and those of Punjab, India, have preserved a continuous flame in their temples, caused by a steady flow of natural gas for centuries. In after years it caused the deadly explosions in the deep coal mines in Europe and America, being known to the miners as fire damp. Its existence in the United States has been known since the first white men crossed the divide and explored the Ohio River watershed, as the Indians invariably conducted them to these natural vents, and, setting fire to them, viewed the effect with a semi-religious veneration. The discovery of vast reservoirs, sealed up in the porous rocks of the United States and Canada, is of recent years. The artesian driller, searching for salt brine, knew of its presence since the first wells were drilled on the western flank of the Appalachian uplift; afterward the driller in search of petroleum encountered it, but by both of these early prospectors it was considered a source of danger and annoyance. It frequently caught fire, causing loss of life and destruction of the drilling outfit by a sudden outburst. It is on record that Washington in 1755 conveyed to the United States a small tract of land in Virginia containing a «burning spring» fed by natural gas.

The earliest economic use of natural gas known in the United States occurred in 1821, when it was used for the illumination of the village of Fredonia, N. Y. A well one and one-half inches in diameter was drilled to a depth of 27 feet near a noted gas spring and for many years supplied the village with 30 street lights.

In 1838 a water well dug at Findlay, Ohio, encountered such quantities of a foul smelling gas that it was abandoned for the original object. It was subsequently covered up and the gas conveyed to a house near by and utilized for domestic fuel and lights for nearly 50 years.

About the year 1841, natural gas was found in a well near Charleston, W. Va., which also supplied salt brine, from which it was separated and for many years used as a fuel for making salt.

More or less natural gas was developed in the rush to find petroleum in the valley of Oil Creek in the winter of 1859 and the year following.

One of the first attempts to employ natural gas for fuel purposes was at a well drilled at Erie, Pa., in 1868, which was soon followed by many others; these wells were only 600 feet in depth and supplied from one to three families each. Titusville, Pa., enjoys the distinction of installing the first modern equipped natural gas plant, as well as the first well drilled for petroleum. This plant was constructed during 1872, 13 years after the first oil well was drilled by Colonel Drake.

During 1873 natural gas was introduced into many of the villages of Butler and Venango counties for light and fuel, being supplied from wells drilled not far distant in prospecting for petroleum. In the year 1875 the first long pipe line (17 miles in length) was built; the pipe used was six and a quarter inches in diameter, supplying the natural gas produced from the Harvey well at Larden Mills, in Butler County, Pa., to a large manufacturing plant known as the Etna Iron Company on the Allegheny River, a few miles above Pittsburgh. In the 10 years that followed slow progress was made in the actual use of the known gas wells; many were utterly ruined by pulling the casing and allowing the inflow of muddy water, which gradually sealed up the rock and prevented the flow; this was after a struggle for years. The gas from other wells was allowed to escape into the air for years. There seemed to be an uncertainty in the minds of all, as to the lasting supply of this natural product.

In the year 1876 the large Haymaker well was drilled in at Murraysville, Pa., but was not utilized until the year 1883, when its product was piped to Pittsburgh. By the close of 1883 a number of pipe lines were supplying Pittsburgh and the Beaver Valley with natural gas from a number of good gas wells drilled in Washington, Beaver and Butler counties. During May 1885, the first natural gas well from the deep Speechly sand was drilled, seven miles south of Oil City, Pa. During the same year the remarkable reservoir of natural gas in the Grapeville pool, near Greensburg, Pa., was also found.

These numerous natural reservoirs at this period with their great initial pressure encouraged the impression that it could be found in almost any locality and that the supply was practically inexhaustible.

In 1885 the large natural gas fields near Findlay, Ohio, became prominent and the year following large wells were also found in Indiana. These latter developments gave additional assurance of its unlimited supply.

In Pennsylvania, Ohio and Indiana immense quantities of gas were consumed in the most wasteful manner and in the extravagant display, which in numerous instances turned night into day. The effect upon witnessing mile after mile illuminated by the burning of escaping wells and torches produced an impression long to be remembered. This extravagance and waste were not realized until many of the then known fields began to show a serious decline in the rock pressure and, knowing the original pressure, it was a simple calculation to show that a large percentage of the quantity of natural gas originally contained in the natural reservoirs had been withdrawn and that something must be done to stop the waste. Even then the reforms were slow and gradual and many companies became bankrupt. It was not until the general introduction of the gas meter in 1890 and 1891 that economy in its use by the consumer was inaugurated. Formerly the natural gas was sold by month, according to the size of the orifice through which it was delivered without regard to the manner of its combustion and use. The meter made it to the interest of the consumer to use this convenient fuel in an economical manner. It is estimated that under the meter system a saving of fully one-half the gas required to accomplish the same results was made. Another economical improvement introduced consists of shutting in the wells when their flow is not required; their closing or opening being regulated by telephone from a central office. The wells are also more carefully watched and the salt water removed by pumps, instead of by blowing out as formerly. The pipe lines were thoroughly overhauled for leaks and the new pipe afterward used was heavier and of larger diameter, being supplied with heavier thimbles or improved rubber-packed joints. In the cities and towns larger distributing mains are used and a greater number of regulators secured — thereby maintaining a more even pressure — throughout all the variations in consumption, due to changes in seasonal temperature. Consult Hager, D., 'Practical Oil Geology' (New York 1916); Johnson, R. H., and Huntley, L. G., 'Principles of Oil and Gas Production' (New York 1916); Thompson, A. B., 'Oil Field Development and Petrol Mining' (London 1916); United States Mines Bureau, 'Technical Paper No. 10' (Washington 1912); Westcott, H. P., 'Handbook of Casing Head Gas' (Erie, Pa., 1916); and 'Handbook of Natural Gas' (Erie, Pa., 1913).

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GAS, Poison. See POISON GAS.

GAS-CARBONIZING PROCESS OF ARMOR PLATE. See ARMOR PLATE.

GAS ENGINE. See INTERNAL COMBUSTION ENGINE.

GAS HOLDER. See GASOMETER.

GAS ILLUMINATION, History of. The development of gas lighting can properly be placed to the credit of the 19th century. Spirit of coal, produced by the distillation of coal, was known as far back as 1739, and the attention of Robert Boyle was called to this substance by Dr. Clayton, bishop of Cork. Its properties were studied and its inflammability and many of its general characteristics were known at this time, although an inflammable gas rising from the surfaces of certain stagnant pools had been noted as far back as 1659. The first practical application of gas for illuminating purposes was made in 1792. William Murdock, an English engineer, produced gas by the destructive distillation of coal in iron retorts and conducted it for a distance of 70 feet through iron pipes and lighted and heated his house in Redruth, Cornwall. Lebon in 1801 illuminated his house and garden in Paris by gas produced from the destructive distillation of wood. This method of illumination proved a failure on account of the poor illuminating power of the gas. In 1802 Mr. Murdock installed a plant for illuminating the foundry of Boulton, Watt & Co. (Watt being the inventor of the steam engine) near Birmingham, and a similar installation was introduced in Manchester shortly after this time. Street lighting was introduced by F. A. Winzer (afterward changed to Winsor) in 1807 in Pall Mall. Mr. Winsor promoted a company for general gas lighting in 1809, and was granted a charter by Parliament in 1810 for the establishment of the London Gas Light and Coke Company, generally known as the chartered gas company.

In America David Melville, of Newport, R. I., was attracted by the developments made along the lines of gas lighting in England, and installed in his house, and in the streets in front of his house, the first gas lights used in the United States. This installation was made in 1806, his apparatus, with improvements, was patented in 1813 and a general installation made in several cotton mills and lighthouses. Baltimore was the first city in the United States to install gas lighting, in the year 1817, and since that time the growth of the gas lighting industry has proceeded uninterruptedly, for its convenience and economy have been impressed upon the public.

The original promoters of gas lighting encountered many difficulties. At the time of the installation of gas pipes in the House of Parliament it was stipulated by this body that no pipes should be placed nearer than six inches to any woodwork. Numerous explosions and fatal asphyxiations caused by lack of experience in handling the new substance are recorded. The disagreeable and often injurious odor of the products of combustion of the gas greatly retarded its favor with the public. With the increasing experience of gas engineers, the dangers of explosions and accidental asphyxiations were eliminated. Considerable inventive genius was brought to bear to remove from the room the products of combustion, or to purify the gas for the removal of those constituents which gave the disagreeable products on burning. Several means were proposed for accomplishing these purposes. The most original improvement, and one in use at the present time, was the invention of Clegg, who introduced the use of slaked lime for removing the sulphurous constituents of the gas before it entered the holders. A later development was that of Lanning, who used ferrous oxide mixed with sawdust or wood pulp to make it porous for the absorption of the sulphur constituents. These methods are to-day in general use. Many other methods, of more or less value, have been proposed.

The illuminating power of a flame is derived from the heating of solid particles to incandescence, and the practice of gas illumination can therefore be divided into two general principles: (1) Where the solid incandescent material is supplied by the decomposition of the gas in the process of combustion; (2) where the complete combustion of the gas is produced by the Bunsen burner, and a permanent incandescing material is supplied as a part of the apparatus.

The latter method is what is generally known as the incandescent gas lighting system. The original developments in gas lighting were made on the first of these principles. The batswing or fishtail flame was produced by releasing the gas through a narrow slit, and its illumination was produced by the incandescence of the solid particles of carbon derived from the decomposing gas in the flame. The Argand gas burner is a modification of the old Argand oil burner, and consists of a ring of small openings arranged near enough together so that the gas flame is in the form of a continuous cylinder, admitting air to the inside and outside of the cylinder. The Siemens-Lungren system, known as the Regenerative system, consisted in applying to the burner gas and air which has been preheated. Professor Bunsen, professor of chemistry in Heidelberg, designed a burner to produce a non-luminous flame with complete combustion and to give the maximum heating effect of the gas. This was accomplished by so constructing a burner that it will carry in and mix with the gas a limited amount of air before it reaches the point of combustion. The additional air necessary to produce complete combustion is drawn from the atmosphere surrounding the flame. This type is known as the Bunsen burner.

The experiments of Henry Drummond in 1826, in which he placed a solid stick of lime in the oxy-hydrogen flame, was the first systematic attempt at the development of what is now known as the incandescent gas lighting system. The Drummond, or lime-light, was until recently in general use for the production of very high power lights, especially in theatres and for stereopticon practice, etc. This system, however, was not applicable to the ordinary conditions of gas lighting. A modification of the Drummond light was made by Tessie du Motay, in which he substituted coal gas for the hydrogen in the ordinary Drummond oxy-hydrogen flame. A burner exhibited at the Crystal Palace Electric and Gas Exposition in 1883, by Lewis, was constructed with a platinum mantle suspended over the flame, and designed to produce a high incandescence. This mantle, however, was unsuccessful, owing to the fact that it rapidly deteriorated by the reducing action of the gas. This burner was designed to operate with compressed air. Clamond about the same time introduced a burner similar to the Bunsen type, in which he placed a mantle made of threads of magnesia. He also introduced an inverted pattern or burner in which a basket or mantle was made of magnesia threads held in a platinum basket. This burner, like the Lewis burner, was operated by compressed air, and was claimed to produce 4½ candles per foot of gas consumed, with a life of from 50 to 60 hours. Mantles in modification of the Clamond type were produced by C. B. Harris, in which he molded a refractory material into sheets, pressed into the proper shape and perforated in any desired pattern. Attempts have also been made to make a mantle of asbestos or similar non-combustible material, and saturate this with a substance giving high incandescence.

The first commercially successful results accomplished in the field of incandescent gas lighting were made by Dr. Carl Auer von Welsbach of Vienna. Welsbach's work in this field began in 1880, in Bunsen's laboratory in Heidelberg, where he was studying the rare earths from a standpoint of pure chemistry. His attention was centred on the oxide of erbium. To produce a continuous light for spectroscopic study he satuated a cotton fabric with a solution of erbium, and after burning out the cotton suspended the residual ash in the flame. This produced an intense green light. The idea occurred to Welsbach to utilize this particular method for producing an ash fabric of incandescing material in the ordinary Bunsen gas flame. When this plan was communicated to Bunsen he replied: "It appears most improbable that the oxides could be made to adhere." Welsbach, however, continued his experiments, choosing not erbium oxide, but oxides which would give a high white incandescence when heated. His researches led him through the entire field of the elements having stable oxides, and certain oxides of the so-called rare earths were found to give the most promising results. The oxide of lanthanum made a perfect mantle in appearance and produced an intense glow in the colorless flame of a Bunsen burner, but the mantle was found to crumble to a powder within a short time. Welsbach then began experiments with a view of mixing something with a lanthanum which would produce a non-slaking body. In 1886 what is known as the lanthanum-zirconium mantle was introduced. This mantle was made by saturating a closely knit cotton fabric with the proper mixture of zirconium and lanthanum nitrates, burning out the cotton and leaving a network of ash composed of the oxides of zirconium and lanthanum. These mantles gave 12 candle power per cubic foot of gas consumed, and lasted several hundred hours. To quote Welsbach: "The sum of all these results appeared encouraging, and I was audacious enough to pronounce the endeavors of the gas engineers to increase the illuminating power of the open flame, as useless and vain; for it was evident that it was much more economical to renounce the lighting power of the open flame and to transform it into a Bunsen flame, and to get those substances to incandesce in the very hot part of that Bunsen flame, by which method two or three times the amount of light of an open flame could be attained."

The invention was now called to the attention of the public, and Welsbach delivered numerous lectures before the press representatives. The invention was named the Incandescent Gas Light by Mr. Sceps, editor of the *Neue Wiener Tägeblatter*. The announcement of the Welsbach mantle was received with various comment, and many prominent engineers refused to take the matter seriously. Welsbach's confidence, however, was not shaken, and companies were formed for the development of the industry and the manufacture of the lighting fluid from the rare earths. The services of Dr. Ludwig Haitinger, an able chemical engineer, were added to those of Dr. Auer in the development of this work. The increased efficiency of this method of lighting, however, was not what had been expected, and the public refused to take it up. The mantle rapidly deteriorated and required to be rejuvenated. At that time it must also be understood that these mantles were very fragile and in the early stages of the work they were delivered in the city of Vienna by a boy carrying one in each hand, as they would not bear the ordinary handling in transportation. The usual skepticism of the public in regard to new inventions prevailed, and the commercial failure of this enterprise seemed imminent. The Vienna factory was closed and the plant and laboratory sold. The American factory, under the direction of Waldron Shapleigh, was still producing with some success the lanthanum-zirconium mantle. Welsbach, however, was not discouraged by these drawbacks, and devoted his entire attention to the development and improvement of the mantle. In the early nineties he went before the public with an entirely new mantle, which was composed of 99 per cent thorium oxide and 1 per cent cerium oxide. This mantle gave 24 candles per cubic foot of gas consumed. The present system of manufacture of mantles is entirely in accordance with this last invention of Welsbach's, which consists in saturating cotton fabric with the proper mixture of the nitrates of thorium and cerium, burning out the cotton fabric and tempering the mantle. It is then coated with collodion and packed for the market. Various improvements have been made in the Bunsen burner and a large number of designs are now on the market; but the general Bunsen principle is strictly adhered to and the present incandescent gas light is invariably produced by applying the incandescing material to the colorless Bunsen burner flame.

The first incandescent gas mantles were of approximately conical form, suspended above the upwardly directed flame from an upright burner by means of a loop in the apex of the mantle. On account of the expansion of the mantle under heat it was impracticable to secure the bottom or "skirt" of the mantle to the burner-head, and the swaying of the skirt against the burner-head with every vibration of the lamp resulted in disintegration of the lower portion of the mantle. In 1907 the inverted mantle and burner were introduced. In this type a mantle of roughly hemispherical form was suspended below the downwardly directed flame of an inverted burner. The open end of the mantle was affixed to the burner-head and thus rigidly supported. Although the inverted mantle greatly exceeded the upright in durability, the arrangement of the burner parts was unsatisfactory in that the burner being below the supporting fixture discolored the latter by the strongly heated combustion products. In 1915 an upright burner bearing inverted mantles was introduced. In this lamp was combined the strength of the inverted mantle and the structural advantages of the upwardly projecting lamp body — particularly desirable for attaching to fixtures designed for the upright open flame tips. Up to this time the development of the gas lighting industry had been much restricted by the above mentioned limitations and the lack of flexibility in the adaptation of gas lamps resulting from these limitations.

Almost coincidentally with the development of the upright inverted mantle lamp it was discovered that by conserving the kinetic energy of the gas through proper design it was possible to control the gas and air mixture so completely that practically any structural combination imposed by the requirements of fixture design or illumination requirements may be realized and the light yield much increased. Although the mantles are best suspended in an inverted position, the burner may be vertically upright or inverted, horizontal or angular. By the application of these principles, incandescent gas lamps ranging from 25 to 2,500 candle power have been successfully operated, and all of the various systems of illumination — direct, indirect and semi-indirect — successfully applied. In connection with other development, refinements in ignition and control have been so elaborated that any desired condition of operation may be met.

Gas for lighting is usually distributed at a pressure of from two to three inches of water column. At these pressures the most recent incandescent gas lamps give from 28 to 30 candle power per cubic foot of gas consumed. For street and factory lighting, higher pressures are coming into use, and at a pressure of three pounds per square inch a yield of from 50 to 60 candle power per cubic foot is obtained.

The wonderful ability of Auer von Welsbach as a chemist and inventor should also be noted, from the fact that the chemicals used in the production of the mantles were very rare and almost unknown, and that he was called upon to find the raw material for the production of these chemicals, and to invent processes for their extraction in a sufficiently pure state for use. All of this work was accomplished successfully after years of patient, painstaking endeavor. Within the past decade the decorative side of gas lighting has been all-appealing. The primary idea of gas lighting was illumination, but with a desire for greater comforts and more luxuries in everyday life has come the desire for decorative effects. Globes, shades and domes are now made in many varieties. Color schemes of beauty are evolved, and artist and artisan combine to lend decorative worth to shape, color and treatment of the globe or shade, which is destined to add to the bare illumination of the gas jet or the incandescent mantle.

In 1917 the entrance of the United States into the Great War imposed radical changes upon the gas practice of the country. The entire production of benzol and toluol (the basis of the most efficient high explosives) from the by-product coke oven plants — the principal source — was under contract to the Entente Allies, and the United States government had recourse to the plants furnishing illuminating gas to obtain its own supply of these needed chemicals. Benzol and toluol are largely responsible for the luminosity of the open-flame gas burner, and the necessity for removing these substances from illuminating gas made the incandescent mantle almost an universal necessity wherever gas was employed for lighting. The mantle burners in use before this time were relatively expensive (when of good quality) and had been restricted to the more important uses, the open-flame burner being used for occasional and intermittent service. In many cities more than one-half of the gas used for lighting was burned in open-flame tips.

In order to make the needed conversion of these less-frequently-used burners to mantle lamps without imposing undue burden upon the consumer, a small, relatively inexpensive mantle burner, of substantially the same light-giving power as the previous open-flame burner was developed. This effects a saving of about two-thirds in gas consumption and permits all the toluol and benzol to be removed from the gas without impairing its light-giving power.

Table showing efficiency of various systems of gas lighting in use at the present time:

System	Candles per cubic foot of gas consumed
Welsbach Incandescent High Pressure (1915)	50 to 60
Welsbach Incandescent Low Pressure (1915)	28 to 30
Welsbach Incandescent thorium-cerium mantle (1907)	22 to 24
Welsbach Incandescent lanthanum-zirconium mantle (1888)	11 to 12
Siemens-Lungren burner	5 to 6
Argand flame	3 to 4
Bray burner	3 to 4
Fish-tail flame	1½ to 3

SIDNEY MASON,
President Welsbach Company.

GAS LIGHTING, High Pressure. High pressure gas lighting represents the most efficient application of the energy in illuminating gas to the production of light, and is the highest development of the use of the Bunsen burner in connection with the Welsbach incandescent mantle. The principle involved is simply the production of high flame temperature within or on a mantle of highly refractory and radioactive elements by the complete combustion of gas in a concentrated flame volume. This principle was first demonstrated before the Philadelphia Chemical Society in 1801 by Dr. Robert Hare, by exhibiting the effect of concentrating the oxy-hydrogen flame on a refractory substance. The term "high pressure" is recognized as distinguishing it from ordinary incandescent gas lighting, because of the fact that the greatest number of lighting appliances coming within this class depend on the gas being supplied at higher pressures than are common in the ordinary distribution of illuminating gas from the works to the consumer. There are other types of units, however, of equally high luminous efficiency which come within this class, but which use the gas at the ordinary pressures, complete and high temperature combustion of which is effected by supplying the air at pressures ranging from one to two pounds above the atmosphere. These types have not met with such general favor as the other, on account of requiring a double pipe line system, one to carry the gas and the other to carry the air under pressure, and also because of the greater amount of compression needed to supply the large quantities of air used.

The lamps of the first type mentioned use gas at two to three pounds pressure per square inch (54 to 81 inches water column). The ordinary pressures at which gas is distributed range from one to four inches water column. These lamps use the energy of the gas under pressure flowing from a small orifice at high velocity to entrain from four to six volumes of air per volume of gas by simple injector action into the Bunsen tube and before being burned the gas and air are thoroughly mixed and pre-heated in the extending chamber from the Bunsen tube. At first high pressure lamps were designed to use the upright mantle, but later developments of the inverted mantle recommend it particularly for this class of lighting, because of the fact that the best incandescent results are obtained by having the mantle conform as closely to the flame as is possible, in order to have all its fibres in the zone of the highest temperature. Inverted mantles for high pressure units are applied to the burners in a soft state, so that in burning off and hardening they assume the exact form of the flame on which they are used. This factor is one of the important elements in the luminous efficiency of high pressure units. For low pressure lighting mantles are furnished which have been shaped and hardened in a pressure Bunsen furnace to a length approximating the size of a low pressure gas flame. It is impossible with gas at low or ordinary distribution pressure to completely burn out and properly shape the mantle fabric.

The increase in efficiency of gas lighting by the use of high pressure gas can be seen from the following comparisons:

Burner	Single unit	Candle power per foot of gas consumed
Flat flame (coal gas)	12 to 16 c. p.	2.4 to 3.2
Flat flame (water gas)	18 to 22 c. p.	3.6 to 4.4
Low pressure incandescent Welsbach burners	60 to 100 c. p.	20 to 22
High pressure gas lamps	250 to 1500 c. p.	50 to 60

The candle-power values of the limits given above are horizontal or maximum candle-power intensities. In the utilization of the heat energy in gas for the production of light, which is really the proper measure of efficiency and energy transferred, we have the following:

Flat flame burner, coal gas:
200 British thermal units per candle power.
Flat flame burner, water gas:
150 British thermal units per candle power.
Low pressure incandescent Welsbach burners:
35 to 30 British thermal units per candle power.
High pressure gas units:
15 to 10 British thermal units per candle power.

From this it is seen that with high pressure gas the ratio of energy input in the form of heat to light output measured as candle power is 20 times that of flat flame gas lighting and three times more efficient than Welsbach burners using gas at low pressures.

High pressure lighting units are supplied with gas by pipe lines connected with a compressor, which by automatic control delivers the gas at the pressure required, or they may be connected direct with mains carrying gas at considerably higher pressure, the pressure in the lines leading to the lamps being controlled by individual reducing governors. High pressure gas lighting has been extensively used abroad for street and ornamental lighting wherever high power units are required. The principal streets of London, Paris, Vienna and Berlin are so lighted with units ranging from 250 to 4,500 candle power each. These lamps are supplied by special steel mains from central compressor stations and as they are independent of the regular distribution gas mains, are lighted automatically from these central stations. A large section of the grounds of the Panama-Pacific Exposition in 1915 at San Francisco was lighted by over 300 1000-candle-power units of ornamental design. These units were equipped with automatic regulators, which delivered the gas at three pounds pressure per square inch, taken from the main distribution system, which carried gas into the grounds for all purposes at 35 pounds per square inch. The general use of high pressure gas for lighting and heating will necessarily be a gradual process on account of the conditions and legal regulations imposed upon the gas industry since its inception when gas was used only for lighting with the appliances then known. The Welsbach mantle was invented in 1886 and soon afterward came into general use, rapidly displacing the flat flame burners, as its superiority was appreciated and recognized. Notwithstanding this radical change in the use of gas for illumination, the old legal regulations restricting gas pressure and specifying the illuminating power of the gas to meet the requirements of an obsolete appliance still are enforced, thereby seriously deterring the advancement of the use of gas for lighting, as well as heating. The same principles which make gas valuable as an illuminating agent apply to its use for heating purposes. Many industrial establishments utilize the advantages of high pressure gas for fuel by installing individual compressor outfits. High pressure lighting may be termed an advance of the art years ahead of the physical condition of the industry. When the legal restrictions referred to are removed, gas will be supplied on the basis of its heating value and at pressures which will ensure the general enjoyment of its latent qualities as demonstrated by high pressure lighting.

F. V. Westermaier.

GAS POISONING, poisoning vapors of various substances when taken into the body through the air passages. Theoretically, a large number of substances used in the arts may cause gas poisoning; practically, there are only a few that seriously endanger health or life.

In general, gaseous substances must reach a certain percentage in a mixture with respirable air before they become poisonous. This percentage varies with each gas. Forms of gas poisoning most commonly met are those incidental to certain of the industrial trades, arising from the inhalation of poisonous gases, or of the fumes of volatile liquids. It is not to be supposed that such poison gases and vapors are allowed to work harm to employees unopposed. On the contrary every effort is made to prevent danger from this cause, and the cases of industrial poisoning by inhalation are very few.

Following is a list of the vaporous poisons against which precautions have to be taken, and a note of the industrial occupations in which they are met with:

Acetaldehyde fumes — in the vinegar industry.

Acrolein vapors — in fat-reducing establishments, oilcloth works, soap and candle factories.

Ammonia — around coke ovens; in the manufacture of ammonia salts; in the making of dyes, varnishes and lacquers; about ice making and refrigerating plants.

Amyl acetate fumes — from Zapone lacquer in several industries; in jewelry manufacture; and in the oilcloth process.

Amyl alcohol fumes — in the manufacture of fruit essences, valeric acid, and in the making of aniline dyes.

Carbon dioxide — in mines; in lime and brick kilns, tanneries and sugar mills; and in breweries and mineral water bottling establishments.

Carbon disulphide fumes — in the manufacture of calcium sulphide; in imitation silk making; and in many industries where it is used as a solvent, as for rubber, resins, fats, oils, etc.

Carbon monoxide — leakage from defective flues in all industries; around coke ovens; in the exhaust and leakage from gas engines; in metal foundries, from drying molds; in charcoal burning; and about lime and brick kilns.

Chlorine — in laundries, bleacheries, paper mills and in the manufacture of organic chlorine products.

Cyanogen (prussic acid) — in the extracting of gold from ores; in silver and gold plating; in dye works; in the manufacture of celluloid; in certain photographic processes.

Diazomethane — in methylizing processes of all kinds.

Dimethyl sulphate — in the production of methyl ethers, methyl esters and methyl amines; in the manufacture of artificial perfumes.

Formaldehyde — in disinfecting processes, and in the manufacture of coal-tar colors.

Hydrofluoric acid — in glass factories, glass etching works, potteries, dye works and fertilizer factories.

Methyl alcohol (wood alcohol) fumes — in the manufacture of varnishes, lacquers and polishes; in the making of perfumes; in furniture polishing; in the production of coal-tar colors; in calico printing.

Methylic bromide fumes — in aniline dye works.

Nitro-benzol fumes — in the making of perfumes, fine soaps and pharmaceutical preparations; in making coal-tar colors; in the manufacture of explosives.

Nitroglycerine fumes — in making explosives.

Nitrous gases — in numberless industries in which nitric acid comes in contact with deoxidizing substances; in chemical works; in the manufacture of celluloid, aniline colors, bleaching materials and dynamite; in dyeing and calico printing.

Phosphuretted hydrogen — in the extraction of phosphorus; in the reduction of iron silicate; in the production of acetylene.

Sulphur chloride fumes — in the rubber industry, and wherever it is used as a solvent for rubber, resins and fats; in making solutions of sulphur.

Sulphur dioxide — in the reduction of sulphurous ores; in potteries and the ceramic industry; in refining petroleum; and extensively in the bleaching of wax, silk and wool, dried fruits, hops, straw hats and bristles; in the fuming of wine casks, etc.

Sulphuretted hydrogen — around blast furnaces; in ultramine works; in soda factories (Leblanc process); in extracting cellulose; in tanneries; in making illuminating gas.

Sulphuric acid fumes — in hat factories; in petroleum refining; in fertilizer factories; in making and caring for storage batteries.

Turpentine oil fumes — in the making of lacquers, varnishes and cements; in tapestry printing; in house painting.

Outside of industrial gas poisonings there has been a number of cases of poisoning by carbon monoxide (CO) both through the medium of illuminating gas, of which it is an important constituent, and also where old-fashioned gas stoves without flues are used, and where there is insufficient air to convert the CO to CO_2. See Carbon Monoxide.

Poisoning by illuminating gas is extremely common, occurring both by intent and accidentally. The character of the poisoning and its mode of treatment will vary with the composition of the particular variety of illuminating gas that may be inhaled. The so-called «water-gas» is particularly rich in CO. The leading symptoms of this form of poisoning are, in the beginning, headache, with sense of pressure in the temples, ringing in the ears, flashes before the eyes, beating of the temporal arteries, dizziness and perhaps unconsciousness. If the breathing of the gas continues, dangerous symptoms develop. There is marked redness of the skin, with unconsciousness; the blood is bright-red — a marked contrast to the dark blood with blueness of the skin seen in carbon-dioxide poisoning. Occasionally there are cramp-like convulsions. The pulse is at first full and strong; later it is thin and small. The breathing is slowed, and becomes a kind of snoring. Vomiting is common, and occasionally the vomit is drawn into the lungs and causes the additional symptoms of suffocation. The patient may die in deep slumber. The diagnosis is not simple, but the chief signs are the reddish face, the snoring breathing, the absence of alcoholic breath and perhaps the slight odor of gas in the room. The treatment should be energetic. The patient should be brought into fresh air at once, the clothing loosened and hot bottles applied to the extremities. Active rubbing of the skin with coarse towels, mustard-water applications to the extremities and artificial respiration should be instituted. The breathing of camphor vapor or well-diluted ammonia gas may stimulate the breathing. So long at the heart beats there are hopes of reviving the patient. The injection into the rectum of large quantities (2 quarts) of hot salt solution (110°–118° F.), a teaspoonful of salt to a pint of water, is of great service. Small quantities of whisky (½ ounce) may be added to this. The transfusion of salt solution into the veins is sometimes necessary, but should be performed only by the medical practitioner.

Where the pulmotor (q.v.) is available it is used almost exclusively in the resuscitation of persons overcome by the inhalation of poisonous gases, and has been successful in cases where the beating of the heart has been suspended for five minutes. Persistence in the operation is required; two or even three hours having been necessary in some cases. The difficulty of carrying it about on account of its weight led to the invention of the respirator (q.v.), similar to the pulmotor, but using ordinary air instead of oxygen, which is not always obtainable in an emergency. The record of the respirator is quite as satisfactory as that of the pulmotor.

In the European War poison gases have been used freely, first by the German army and later by their foes. The German gases were at first a mixture of chlorine and sulphur dioxide, which rolled along the ground to a height of about seven feet and filled the trenches. In one recorded instance the cloud of gas rose to a height of 40 feet, and this was maintained along a stretch of five miles for the space of four hours. The effect upon those not immediately killed by the inhalation of this mixture was to produce irritation and swelling in the bronchial tubes, with many of the symptoms of acute bronchitis. The inhalation of ammonia gas gave relief, but most cases became speedily worse on the third day, and succumbed. Nitrous acid gas has also been used alone and in mixture, both in the clouds of gas sent rolling over the ground, and in the gas shells dropped into trenches and gas bombs dropped from aeroplanes. Bromine has also been used. To protect the soldiers from these attacks gas masks were devised. They consist of a face piece in which is placed an absorbent filling containing a mixture of sodium thiosulphate, 72 per cent; and sodium bicarbonate, 28 per cent and 2 to 3 per cent of glycerine to keep them moist. These masks are effective for two and a half minutes in air containing 10 per cent of chlorine, and twice as long if the chlorine content is only 5 per cent. One part of chlorine in 1,000 parts of air is instantly fatal when inhaled. One part in 100,000 of air, if inhaled for any length of time, is highly injurious. The German treatment of their own gassed men is by hypodermic injection of atropine.

Consult Dion, S. A., 'Tanks, Gas, Bombing, Liquid Fire' (New York 1917); Glaister, J., and Logan, D. D., 'Gas Poisoning in Mines and Other Industries' (Edinburgh 1914); Roberts, A. A., 'The Poison War' (London 1915); United States Bureau of Labor Bulletin 100, 'List of Industrial Poisons and Other Substances Injurious to Health Found in Industrial Processes' (Washington 1912), and Bulletin 179, 'Industrial Poisons Used in the Rubber Industry' (1915).

GAS PRODUCER. The preliminary requirement in using any form of fuel is its conversion into a gas in order that it may combine more readily with the oxygen in the combustion process. Whether the gas thus obtained is combustible, i.e., whether it enters into combination with oxygen with the production of heat, or otherwise, depends upon the nature of the fuel from which it is derived and upon the method of gasification employed.

In most fuels, the chief combustible elements are carbon (C) and hydrogen (H), which are present in a great variety of chemical combinations with varying physical characteristics. When these fuels are completely burned, the products of combustion contain only carbonic acid (CO_2) and water (H_2O), with nitrogen (N) and some of the oxygen (O) of the air supplied for combustion, all of which are incombustible. But when the fuel is incompletely or partially burned, the products of combustion will also contain varying quantities of carbon monoxide (CO), various forms of hydrocarbons (CH_n), hydrogen, and sometimes tar and smoke as the products of distillation, all of which are combustible or have a heating value, which is wasted if not oxidized in the combustion processes.

Fuels may be burned by either direct firing on a grate or after conversion into gaseous form. The ultimate object of direct firing is the attainment of complete combustion in close proximity to the fuel bed, by vaporizing, distilling, gasifying and completely burning the fuel elements within the same chamber. It is well known, however, that the processes of vaporization and distillation do not produce heat but, on the contrary, absorb it, and, therefore, it is advantageous to separate them from the point at which the combustion of the gases takes place, and where high temperatures are developed by the heat evolved, as is accomplished by the use of a gas producer or generator.

Generation of Producer Gas.— In the gas producer, the processes of vaporization, distillation and gasification result in the generation of combustible gas, which is led away to a separate combustion chamber in which it is subsequently burned under conditions more favorable to a full realization of the heat value of the fuel, and the high temperatures absolutely unattainable by any other method of firing.

It should be clearly understood, however, that the use of a gas producer does not enable the generation of a greater quantity of heat than may be obtained by direct firing. Even when the producer is closely connected to the furnace so as to utilize the sensible heat of the gas, a loss of energy of from 15 to 20 per cent of the calorific value of the fuel is sustained; but notwithstanding this loss, practical experience has demonstrated that the gas producer accomplishes, with much less fuel, practical results equal to those obtained by direct firing and has made possible metallurgical operations impracticable by the latter method.

The advantages of gas firing over direct firing will be better understood by a brief discussion of the manner in which producer gas is generated.

As already stated, the products of the incomplete combustion of a fuel contain various combustible elements which are susceptible of being burned at a higher temperature than that of the original combustion, and producer gas is simply the product of an incomplete combustion or, more exactly, a distillation of a fuel in the generator.

The oxygen of the air admitted to the producer comes in contact with the incandescent carbon of the fuel and forms a certain amount of incombustible carbonic acid gas or carbon dioxide (CO_2). The heat evolved by this reaction is absorbed by the CO_2 thus formed and by the nitrogen of the air supplied. These gases ascend and yield their heat to the fuel above and bring it to the point of incandescence, so that the CO_2 first formed is brought in contact with this glowing carbon, and taking up an additional quantity of carbon is converted into the combustible carbon monoxide (CO). In a word, then, the primary object of the gas producer is to convert carbonaceous fuel into carbon monoxide gas.

If this gas is generated with dry air in contact with fuel free from impurities, it will still contain all the nitrogen of the air and will be composed approximately of carbon monoxide (CO), 34.7 per cent; nitrogen (N), 65.3 per cent by volume, and will possess a heating value of about 118 British thermal units per cubic foot.

In actual practice, however, it usually contains also a certain amount of carbon dioxide CO_2 and a little hydrogen (H), the H being derived from the fuel and the decomposition of the moisture in the air supply when it comes in contact with the glowing carbon.

When fuels such as soft coals are used, the products of distillation of the raw fuel in the upper zone of combustion, consisting chiefly of hydrogen and the hydrocarbons — marsh gas (CH_4) and olefiant gas (C_2H_4) will become mixed with the products of gasification in the zone below.

Air when passed over incandescent carbon maintain a given quality of gas with a minimum percentage of CO_2. Practically, however, the heat employed must not be so great as to destroy the producer, and the lower the exit temperature of the gases the better.

It is important to note that wet coals retard the development of high temperature in a gas producer, on account of the great heat expenditure required for the vaporization of such water; and also, that for like reasons, carbonized fuels work at a higher temperature than uncarbonized fuels.

A condition which affects favorably the percentage of combustibles in the gas is the presence of steam in the air supply. Blowing with air alone introduces a large amount of inert nitrogen which dilutes the gas and reduces its calorific value. On the other hand, the use of steam increases the percentage of combustibles by adding hydrogen and supplying in its dissociation a quantity of oxygen which is not diluted with nitrogen, thus increasing the calorific value of the gas, reducing its exit temperature and preventing clinkering.

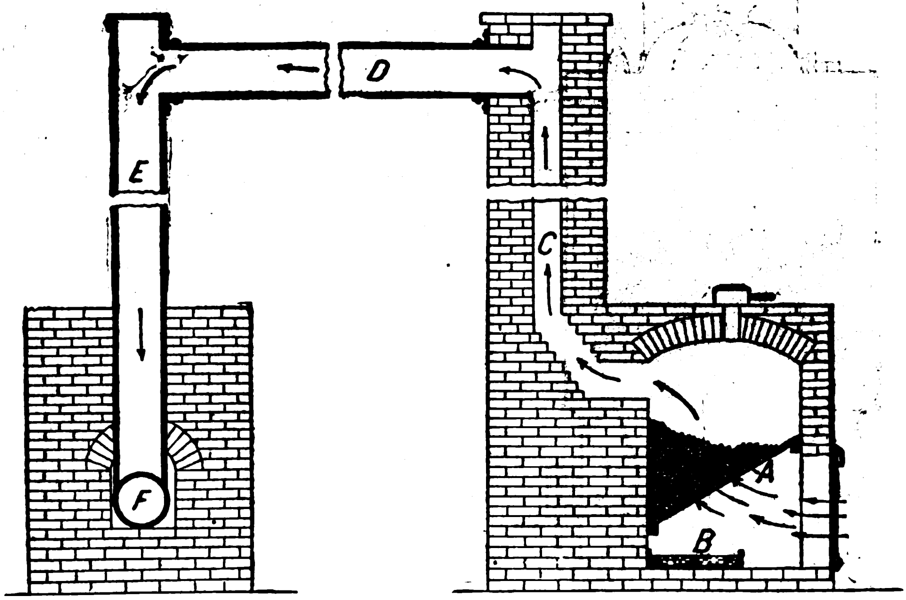

Fig. 1.—Sectional Diagram, Siemens Gas Producer.

(C) gives minimum CO_2 at a temperature of 2000 F., therefore, the temperature of the producer should be kept above this point. Furthermore, the formation of CO is greatly affected by the character of the fuel and the depth of the fuel bed, so that the greater the depth of the fuel bed and the more finely divided the fuel, provided it does not offer too much resistance to the passage of the air and gases, the greater will be the percentage of CO formed.

Other things being equal, the higher the temperature of the producer the greater will be the amount of fuel gasified per unit of time, but as this depends largely upon the air supply, an increased air supply signifies more rapid combustion, greater velocity of the gases through the fuel bed, briefer contact of the gases with the fuel, and, therefore, indicates that a greater depth of contact is required if it is desired to

The use of steam does not, however, result in the production of a greater amount of heat in the producer. The heat is simply transferred from the generator to the furnace by the higher potential heat value of H, instead of the less efficient, though greater sensible, heat in the gas itself. In practice it is found that not all of the water content of the air-blast is converted into hydrogen and oxygen. A small percentage slips through unchanged, and in the combustion chamber of the furnace absorbs heat in its dissociation, and, to that degree, reduces the temperature of the furnace. For this reason the amount of water supplied (as steam) must be carefully regulated according to the amount of moisture present in the fuel. When the fuel is dry and highly carbonized the equivalent of one pound of water may be injected with each 80 cubic feet of air at ordinary temperatures. If the air-blast and steam are preheated, say to 1000° F., one pound of water may be injected with each 40 cubic feet of air. With fuel of the composition of bituminous coal one pound of water is supplied with each 85 feet of air.

It is apparent, therefore, that the composition of producer gas is likely to be very variable, owing in the first place to the lack of uniformity in the fuel, and secondarily to the varying adjustments of the air and steam supplies and the degree of heat at which the gas is produced. An analysis of producer gas made from Illinois bituminous coal showed, in combustible constitutents: Carbon monoxide, 15.12 per cent; hydrogen, 9.98 per cent; methane (marsh gas),

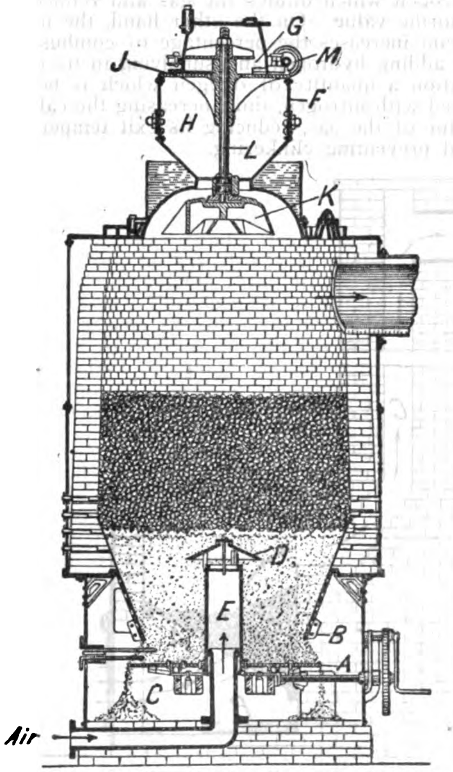

Fig. 2.—Vertical Cross-Section, Taylor Gas Producer.

6 per cent; and of incombustible constituents: nitrogen, 59.06 per cent; carbon dioxide, 9.72 per cent; and oxygen, 0.12 per cent. Where the gas is not used directly as it comes from the producer, but is cooled and the moisture content condensed, a larger quantity of water may be used during gasification, with the beneficial effect of reducing the nitrogen content to or slightly below 50 per cent, and replacing the 9 or 10 per cent thus eliminated with hydrogen. The percentage of carbon dioxide will be larger in the case of fuels with a low melting slag, as in such cases the temperature of the producer must be kept so low that not all of the dioxide is transformed into monoxide. A higher percentage of dioxide than 4 or at most 5 per cent is objectionable and indicates that the producer is not working properly, or that its fuel is not suitable for making profitable producer gas.

Types of Gas Producer.— Gas producers have been developed after two general types: (1) The Siemens gas producer, which operates without artificial blast and is typical of the older producers; and (2) the Taylor producer on the plan of the blast furnace, equipped with a rotative ash table and operating with a forced steam-blast, and representing the later developments in this line.

Fig. 1 shows a vertical section through a Siemens gas producer and regenerator furnace. It consists of two essential parts — the gas producer proper in which the raw fuel is converted into a combustible gas and the furnace with its regenerators or chambers for storing the waste heat of the flame, given up to the incoming air and gas. As the air is drawn into the producer through the firebars *A*, a certain quantity of the water contained in the trough *B* is vaporized by the heat of the fire above, and mixing with the air is drawn with it into the fire. The necessary indraught of air, and the pressure required to cause the gas generated in the producer to flow into the furnace, is obtained by means of the vertical uptake *C*, usually built of brick; the horizontal iron tube *D*, of relatively large diameter; and the vertical tube *E*, leading to the gas flue *F* of the furnace. By this arrangement, as the hot gas rises from the producer and passes through the tubes, it is considerably reduced in temperature, thus rendering its density much greater at the furnace end than at the producer, and thereby causing a suction and an indraught of air at the latter. This type is practically the one used in all plants making illuminating gas.

Fig. 2 shows a vertical cross-section of a Taylor producer charged with anthracite coal. The incandescent fuel is supported by the bed of ash put upon the rotative ash table *A*, before firing, and kept there constantly as an essential feature in the successful operation of the producer. The rotative ash table has a greater diameter than the bosh *B*, and is placed at such a distance below the latter that upon being revolved, the descending ash forms its own slope at an angle of about 55°, and is discharged uniformly by gravity over the periphery of the ash table into the sealed ash pit *C*.

When operated regularly, the line between the ash and the fuel is kept always about six inches above the cap *D* of the central air pipe *E*, thus allowing the fire to come in contact only with the brick lining, so that all the iron work is protected from the heat. The height of the fire line is maintained by grinding or revolving the ash table once every 6 or 24 hours, according to the rate at which the producer is worked.

The air blast is furnished, usually, by a steam jet blower, but a fan blower may be used if more convenient, and a pipe from some auxiliary source of steam run into the vertical air pipe to supply the steam required for softening. the clinkers and maintaining the proper temperature of the producer.

The producer as shown is equipped with a Bildt continuous automatic feed device *F*, consisting of a receiving hopper *G*, which surmounts the main storage magazine *H*, the communication between the two being regulated by a horizontal rotary register *J*, operated by a lever. The distributor plate *K* is suspended below the main magazine, and supported by a steel shaft *L*, which passes upward through the storage cylinder. Both the hood of the distributor plate and the inverted conical base of the magazine are water-cooled, the tendency of the cooling water and the location of the plate above the gaseous current tending to facilitate the discharge when using strongly caking coals. The receiving hopper is rotated by means of a worm wheel and worm-drive attached to the upper end of the shaft, and the distributor plate is rotated by means of the radical arms and hub of the receiving hopper, which are also keyed to the steel shaft. A hand-wheel nut upon the threaded end of the axis affords means for adjusting the distance between the distributor plate and the coal reservoir, and this adjustment, together with the variable speed secured by means of the stepped cone pulley *M*, permits of a ready control of the rate of coal discharge. Experience shows that the use of feeders equipped with distributing plates not only tends to reduce the amount of furnace wear, labor and repairs, but also results in a great reduction in the coal consumption.

of the producer gas into the cylinder of the engine, are effected by the suction or aspiration caused by the forward stroke of the piston.

Although the pressure system is composed, usually, of more cumbrous apparatus, and requires more space, it possesses greater elasticity than the suction system for meeting variations in the quality of fuel and greater capability for utilizing different kinds and cheaper grades of fuel. It is also the better for use with large power-producing units, or where several gas engines receive gas from the same producer plant.

On the other hand, for isolated plants of small capacity, or where only a single gas engine is used intermittently, the application of the suction system not only simplifies the bulk and reduces the cost of the plant, but what is more important, it makes the demand of the engine for gas the controlling factor of its generation from solid fuel.

Pressure Gas Producer System.— Fig. 3 shows the general arrangement of a pressure gas producer system. Usually it consists of a

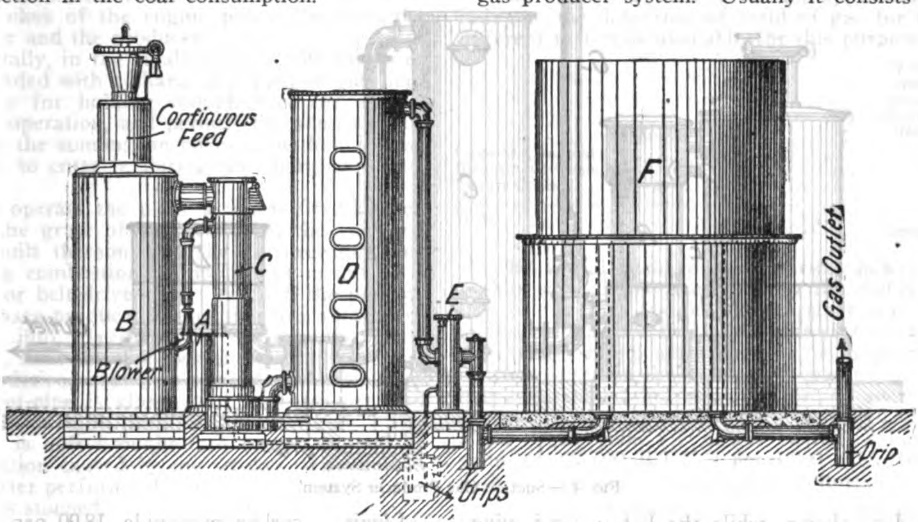

FIG. 3.—Pressure Gas Producer System.

The following table gives the average analyses by volume of the gas produced by the two types of producers:

CONSTITUENT	Siemens Gas	Taylor Gas
Carbon monoxide (CO)	23.7	27.0
Hydrogen (H)	8.0	12.0
Marsh gas (CH_4)	2.2	2.5
Carbonic acid (CO_2)	4.1	2.0
Nitrogen	62.0	56.5
	100.0	100.0

Gas Producer Systems.— Through the methods of operating gas producers of all types have sprung two general but well-defined systems of gas production for power purposes — the pressure system and the suction system.

In the pressure system, the air required for combustion and for the generation of the gas is supplied to the gas producer under pressure, and the gas generated is delivered under pressure to the engine using it.

In the suction system, both the passage of the air through the producer, and the introduction

small steam boiler *A*, for making steam, or producing the necessary air pressure; a gas producer *B*, with a continuous-feed arrangement; an economizer *C*, with superheater and washbox; a scrubber *D*; a purifier *E*; a gas holder *F*, consisting of a steel tank; and suitable drips and connections.

The details of the several organs may be modified to adapt them to varying conditions. For example, the boiler may be omitted where steam can be obtained from some other convenient source of supply, and in some cases a separate steam generator is not absolutely necessary.

For smaller equipments, or those employed for operating engines up to 500 horse power, single producers are generally considered sufficient, but the larger equipments require two or more producers, which may be varied in design and arrangement.

In the operation of a plant of this type, the gases generated in the producer enter the superheater and economizer. In the latter, the air blast of the producer travels in a direction opposite to that of the blower, and the gas passing through the wash-box deposits a large portion of its extraneous matter. The economizer also contains the seal arrangement against the gases stored in the holder and present in the other organs of the plant. From the wash-box the gas passes into the scrubber, the compartments of which are filled with coke. Here the gas is showered by water sprays, and still further purified by the removal of any tar, sulphur or ammonia that may be present prior to its introduction into the purifier where the final purifying operations are performed. From the purifier the gas passes into the holder, which stores a supply sufficient to start and run the plant for several minutes, but the main function of the holder is to regulate the pressure, and care for variations in the consumption and mixture of the gases.

The drip pots and drainage pipes are very essential parts of the plant and are suitably placed as shown, while the hot water issuing from the top of the producer is carried by suitable pipes to the holder.

In the pressure systems all of the following named or similar materials may be used for fuel: Anthracite and bituminous coals, lignites, coke, charcoal, wood, peat and tanbark. Good anthracite coal is the best when convenience of operation is the primary consideration. When bituminous coals are used, preference should be given to those of the semi-bituminous class. According to general experience, soft-coal plants appear to be more expensive than those operated with hard coal, and when the price of anthracite does not exceed that of soft coal more than $1 per ton, it is advisable to employ a hard-coal plant. When coke is used it should be in small pieces of about one cubic inch; as the tendency of large-size coke is to give a weak gas. When coke is used instead of anthracite, one-third more, by weight, of the former should be taken as the fuel consumption.

A variation of the pressure producer is the down-draught apparatus, used for lignite and similar low-grade fuels. The tarry gases are driven down through the incandescent fuel, and the tar is thus split up into its gaseous constituents. The gas outlet for producers of this type is near the grate. Another device to accomplish the same result conducts the tarry gases from the top of the producer by an outside pipe downward to the base of the producer whence they pass again through the fire. A still more successful type has two fire zones, one at the top of the fuel mass and the other at the bottom, the gas outlet being between the two. Doubling the producer is also effective, one of the two being fired with anthracite, and the gases from the low-grade fuel in the other being passed through its fire.

The constitution of producer gases from various fuels as made in a pressure plant is as follows:

Coke — carbon monoxide, 27.6 per cent; hydrogen, 7 per cent; methane, 2 per cent; carbon dioxide, 4.2 per cent; nitrogen, 58.6 per cent.

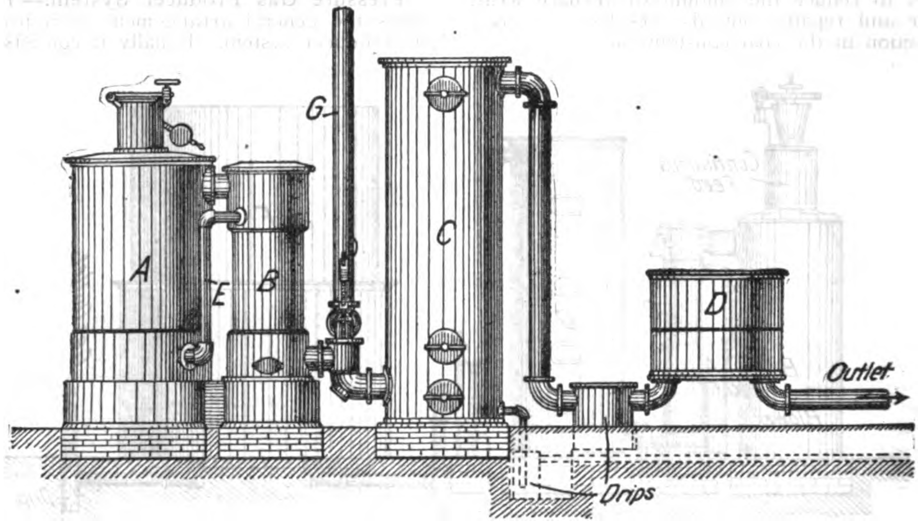

Fig. 4.—Suction Gas Producer System.

Lignite — carbon monoxide, 18.90 per cent; hydrogen, 15.13 per cent; methane, 3.65 per cent; carbon dioxide, 9.43 per cent; nitrogen, 52.50 per cent.

Peat — carbon monoxide, 28.6 per cent; hydrogen, 8.5 per cent; methane, 2.2 per cent; carbon dioxide, 6.9 per cent; nitrogen, 53.8 per cent.

Wood — carbon monoxide, 9.86 per cent; hydrogen, 54.14 per cent; methane, 3.45 per cent; carbon dioxide, 21.30 per cent; nitrogen, 10.53 per cent.

Fuel oil — carbon monoxide, 11.40 per cent; hydrogen, 5.37 per cent; methane, 5.87 per cent; carbon dioxide, 4.10 per cent; nitrogen, 67 per cent.

The by-product gas producers used in the manufacture of illuminating gas separate and accumulate the tar, which is 38 per cent oil, and reclaim a large part of the nitrogen as ammonia. The latter passed through a sulphuric acid bath yields 80 to 90 pounds ammonia sulphate per ton of coal.

Suction Gas Producer System.— Fig. 4 shows the general arrangement of the several organs of a suction plant: *A*, represents the producer; *B*, the evaporator; *C*, the scrubber; and *D*, the receiver. The plant operates as follows:

The gases generated in the producer pass through the evaporator, which is simply a small multitubular boiler, and serves to utilize the sensible heat of the gases for evaporating the water used as steam in the producer. The vapor thus obtained is conducted through the pipe *E*, to the ash-pit of the producer, by the suction of the engine piston, while at the same time the gases pass from the evaporator to the scrubber filled with coke. As these gases rise through the interstices of the coke they come in contact with the descending washing water, which not only takes up and thus removes the dust brought over from the producer, but also purifies the gases of ammonia and any other impurities which water will absorb. From the scrubber, the purified gas passes into the receiver. The diameter of the receiver is relatively large as compared with that of the suction pipe of the engine, and thus prevents the pulsations which would otherwise be caused by the strokes of the engine piston, between the receiver and the producer.

Usually, in the smaller plants, the producer is provided with a charging hopper of sufficient capacity for holding enough fuel for several hours' operation, and permits the admission of coal to the combustion chamber without allowing air to enter it, during the charging operation.

To operate the plant a fire is first kindled upon the grate of the producer; the fuel bed then built thereon, and the air necessary for starting combustion is supplied by means of a hand- or belt-driven fan. At first, the poor or lean gases produced at starting are allowed to escape into the open air through the vent-pipe *G*, until the test-cock shows that good gas of the desired quality is being generated. Then the vent-pipe is closed and the scrubber and receiver brought into the gas circuit. The engine is now brought into operation, and as the suction caused by the strokes of its piston thereafter performs the function of the fan, the latter is stopped.

In the suction systems only anthracite coal, and the so-called carbonized fuels such as gas-house coke and charcoal, have been satisfactorily used up to the present time. When anthracite is used it should not be less than "pea" size, clean and of good quality. It is evident that the finer the size of the fuel and the greater its tendency to clinkering, the greater will be the amount of work required of the engine to draw the air current through the fuel bed. Therefore, if continuous action and easy operation are desired, the use of anthracite of the ordinary "nut" size will give the most satisfactory results.

The following table shows average analyses of the gases produced by the two systems.

ELEMENT	Per cent. Pressure Plant	Per cent. Suction Plant
Carbonic acid (CO_2)	8.2	8.0
Oxygen (O)	.7	
Carbon monoxide (CO)	19.5	26.3
Hydrogen (H)	16.5	18.2
Marsh gas (CH_4)	2.9	0.5
Nitrogen (N)	52.2	47.0
	100.0	100.0

In either case the gas produced is of good quality, when good fuel is used, the pressure-producer gas averaging about 125 B.T.U.'s per cubic foot, and the suction-producer gas about 145 B.T.U.'s per cubic foot, with variations according to the method of operation, and the proportion of hydrogen and carbon monoxide present.

In the power-plant operation, the fuel consumption will average one and one-half pounds of coal per brake horse-power hour for small powers, and decrease in relative amount with the increase in the size of the engine until a rate of one pound per brake horse-power hour is attained, thus giving a higher efficiency than that of the best marine steam engine or the largest steam pumping engine in the world.

Quality of Gas for Power Plants.— In considering the quality of a gas suitable for the production of power or for use in gas engines it is necessary to inquire into the amount and quality of gas obtainable from various kinds of fuels.

The following table gives an approximate index to the difference of yield of gas for the different materials available for this purpose.

MATERIAL	Yield per pound in cubic feet
Coke or Charcoal	104
Bituminous Coals	75
Brown Coals	55
Peat	45
Wood	35

The actual yield of gas varies, however, within wide limits, according to the composition of the fuel, its general character and the method of classification, and in the care of coal, as already stated, according to the proportion of steam used in the producing operations. It may be assumed, however, that on the average, one ton of anthracite buckwheat coal will yield about 170,000 cubic feet of gas, having a calorific value of 138,000 B.T.U.'s per 1,000 cubic feet; with an average composition as follows:

ELEMENT	Per cent.
Carbon monoxide (CO)	22.0 to 30.0
Hydrogen (H)	15.0 " 7.0
Marsh gas (CH_4)	3.0 " 1.5
Carbonic acid (CO_2)	6.0 " 1.5
Nitrogen (N)	54.0 " 60.0

Advantage of Using Producer Gas.— The advantage to be derived from the use of producer gas may be briefly stated as follows:

The combined efficiency attainable in the best steam engines and boilers, operating under the most favorable conditions, is about 12 per cent of the intrinsic heat energy of the fuel used. On the other hand, the modern gas engine, even in small powers, will give an efficiency much higher, but if it be supplied with illuminating gas for fuel, a large amount of the economy due to the higher efficiency is lost in the cost of the gas. Heat energy in the form of coal gas at a dollar per thousand feet, costs 13 times as much as an equivalent amount of energy in the form of coal at \$3 per ton; therefore, in order to utilize a gas engine to its full advantage, the gas used must be produced as economically as possible. This is exactly the function of the gas producer, and by its use a good gas engine with a theoretical thermal efficiency of 75 or 80 per cent, or a practical thermal efficiency of 25 or 30 per cent, will readily convert into actual work, or available power, 25 per cent of the heat energy of the gas delivered to it. The gas producer of such a plant will transfer to the gas about 80 per cent of the intrinsic energy of the coal, so that a gas-producer engine operating on an inferior grade of coal will show an efficiency of 20 per cent, as against the 12 per cent of a steam engine and boiler plant using the best steaming coal. Producer gas is used to great advantage in many industrial operations, among which may be mentioned the manufacture of high degree sulphuric acid; the regeneration of bone black; in the enameling processes; in making lime, cement, glass, brick, china and porcelain; in reverbatory furnaces, especially for small castings; in puddling furnaces in the steel industry; in reheating and annealing furnaces, etc.

Consult Askling, C. W., and Roesler, E., 'Internal Combustion Engines and Gas Producers' (London 1912); Hirshfeld, C. F., and Barnard, W. N., 'Elements of Heat-Power Engineering' (New York 1915); Jones, F. R., 'The Gas Engine' (New York 1909); Miller, J. C., 'Power Gas and the Gas Producers' (Chicago 1910); Nagel, O., 'Producers Gas Fired Furnaces' (New York 1909); Robson, P. W., 'Power Gas Producers: their Design and Application' (London 1908); United States Mines Bureau Technical Paper 20, 'The Slagging Type of Gas Producer' (Washington 1912); Wimperis, H. E., 'Internal Combustion Engines' (London 1915).

Revised by RICHARD FERRIS.

GAS TAR. See COAL TAR.

GAS TURBINE. See INTERNAL COMBUSTION ENGINE.

GASES, Compressed. In general it may be stated that all gases are included under this head, all being compressible to a greater or less extent. Specifically, however, the term has come into use in the industries where it is used to designate those gases which by compression are reducible to liquids and in this state are more easily transported and adapted to industrial uses. The most characteristic feature of the gaseous state is the law or relation which obtains between the volume and tension of a mass or quantity of gas. When pressure is applied to such a mass its volume diminishes until its tension balances the pressure. Provided the temperature is constant, the general principle will be observed that the tension is in inverse proportion to the volume — the greater the tension the less the volume, and vice-versa, when expansion is permitted, the tension decreases in exact proportion to the increase of the volume. Here it is possible to state the general law that the product of the tension and the volume of a gas mass maintained at an invariable temperature remains a constant quantity under moderate pressures; thus, if T,T′ represent the tensions at different pressures and V,V′ the volumes. Since the tension and volume are in inverse proportion, as above stated we have: $T : V' :: T' : V$, or $TV = T'V'$. Boyle discovered and stated this law in 1662 and it was subsequently verified by Mariotte. Under high pressures, however, the law does not hold, but here a modification has been suggested by Van der Waals. The law of Boyle indicates rather a typical condition of gaseous bodies and not a state which is met with in practice. No known gas conforms exactly to the law. Generally the tension increases less rapidly than the law states, while in the case of hydrogen the tension increases more rapidly than the volume diminishes. In practice, however, the deviations are negligible in the case of hydrogen, oxygen, nitrogen, the hydrocarbon gases, nitrous oxide, and a few others; while with other gases the deviations are very marked, and increase rapidly with the pressure. Through the means of pressure and cold all gases may be reduced to liquids when pressure is applied by means of a piston, to a mass of sulphur dioxide gas, for example, the volume is reduced and the tension increased. The latter, however, increases in a lessening ratio up to a certain value, upon attaining which, a further reduction in volume does not further increase the tension, but a part of the gas becomes a liquid, and with further pressure the remainder of the gas also assumes a liquid state.

The more important compressed gases used commercially and medicinally at the present time are the following: acetylene, anhydrous ammonia, argon, carbon acid gas, chlorine, hydrocarbon gases, hydrogen, nitrogen, nitrous oxide, oxygen, and sulphur dioxide. For the historic, scientific, commercial, and economic phases of these gases, also the manufacturing methods, accessories and appliances used in the industry and the distinctive legislation affecting it see LIQUEFIED AND COMPRESSED GASES.

GASES, Joule's Law of; Boyle's or Mariotte's Law of; Gay-Lussac's Law of; Regnault's Law of; Absolute Pressure; Absolute Temperatures; Adiabatic Expansion or Compression; Density of; Isothermal Expansion and Compression; Specific Heat of. See LIQUEFIED AND COMPRESSED GASES.

GASES, Kinetic Theory of. The theory which regards gases as aggregates of discrete particles (or "molecules") of matter that are incessantly flying about and colliding with one another, the space in which they are moving being presumably absolutely vacuous, save for the omnipresent luminiferous ether. (See ETHER). According to this theory, the molecules which are in the outer parts of a given mass of gas must beat incessantly upon the walls of the containing vessel, flying back again from these walls in the same way that they fly away from one another after collisions among themselves. This being the case, it is plain that the walls of the containing vessel are in the same condition as a target against which a furious storm of bullets is striking perpetually. Such a storm of bullets would tend to force the target in the direction in which the bullets were moving before collision; and if the impacts were frequent enough, they would have an effect upon the target which could not be distinguished from a continuous pressure. And if we pass, in thought, from target to retaining vessel, and from bullets to molecules, we shall have a good conception of the kinetic theory of gaseous pressure. Before the behavior of molecular aggregates can be studied by mathematical methods, it is necessary to make certain assumptions with regard to the nature of the molecules. Some of the received assumptions have been made on account of their apparent necessity, and others have been made for no reason whatever, except that they simplify the mathematical treatment of the problems that arise. Thus molecules are assumed to be perfectly elastic, because it has been held to be evident that if they were not so, their incessant collisions must result in a gradual loss of velocity, which would not cease until they were all at rest. The assumption of perfect elasticity is therefore commonly regarded as a logical necessity, since we do not observe any tendency toward rest among the molecules of gases; that is, we do not perceive any tendency toward a fall of pressure, in a gas that is isolated, thermally and otherwise, from its environment. In the earlier mathematical investigations of the properties of gases, from the standpoint of the kinetic theory, the molecules were assumed, furthermore, to be exceedingly small (practically mere physical points), and they were considered to be hard, smooth and spherical and to exert no influence upon one another when not in actual contact; these assumptions being made, not because it was considered to be in the least degree likely that molecules have such properties, but merely in order to lessen the mathematical difficulties involved in the subsequent analysis — difficulties that are serious enough, even when the problem is made as simple as possible. For example, they were assumed to be hard, in order that collisions might be considered as having no sensible duration. They were assumed to be exceedingly small, in proportion to the space in which they move, in order that the probability of a collision in which three or more molecules should come together at once might become vanishingly small in comparison with the probability of a collision in which the molecules come together in pairs, the discussion of the more complex collisions being thereby avoided. They were assumed to be spherical, because spheres can collide with each other in only one way; whereas other bodies (cubes, for example) can come together in the greatest variety of ways, according to their relative orientation at the moment of collision. They were assumed to be smooth, in order to avoid the necessity of taking account of the rotations that are produced when rough spheres glance against one another obliquely. The assumptions stated above were adopted in what may be called the Maxwellian period of the development of the kinetic theory and Maxwell and other mathematicians made elaborate investigations of the behavior of a practically infinite number of molecules having these properties, when once set in motion in a finite space.

Following are a few of the results obtained by the mathematical study of such molecules as are defined above. It is evident, in the first place, that the velocities of the various molecules will not all be equal; for even if such equality existed at any given instant, it would be quickly destroyed by the inter-molecular collisions. Maxwell investigated the distribution of velocities that must subsist in a gas composed of such molecules and gave a formula by which it is possible to calculate, at any given instant, the number of molecules that have velocities greater than, or less than, any assigned velocity. Thus if the total number of molecules present be taken as unity, the number having a velocity less than the average velocity is 0.533; the number having a velocity less than one-half the average velocity is 0.112; the number having a velocity less than twice the average velocity is 0.9829; and the number having a velocity greater than four times the average velocity is 0.0000000074. It appears, therefore, that although any velocity whatever is theoretically possible (so far as Maxwell's formula is concerned), the incessant collisions bring about a sort of averaging which is effective enough to ensure that an almost vanishingly small proportion of the whole number will be actually moving with a speed as great as four times the average. The number having higher velocities falls off with still more remarkable rapidity; for example, the formula shows that less than one molecule in 10[illegible] will be moving with a speed as great as 10 times the average. When two or more different kinds of molecules are simultaneously present, all the molecules in any one set being exactly alike and very numerous, and every molecule being hard smooth, small, spherical and perfectly elastic, Maxwell found that the different sets will mix with one another uniformly, and that the velocities in each set will be distributed precisely as though the other sets were not present. The average velocity in each set will be different, however, from the average velocity in every other set, the set in which the molecules are heaviest having the smallest average velocity. In fact, the velocities, in such a case, will be such that the average kinetic energy of a molecule of one set will be precisely equal to the average kinetic energy of a molecule of any other set.

Some of the mathematical difficulties that appeared almost insuperable to Maxwell have been partially overcome by other mathematicians, and, largely owing to the labors of Boltzmann, we now have a far more general form of the kinetic theory of gases. Before stating the nature of the generalizations that Boltzmann effected, it is necessary to offer a short explanation of the expression «degrees of freedom.» A mathematical point is completely defined when its three co-ordinates are given; it can move by the variation of any one of these three co-ordinates, while the other two remain constant. Such a point is therefore said to possess three «degrees of freedom.» A rigid body in space similarly has six degrees of freedom. Three co-ordinates must be given in order to fix the position of some one of its points — say its centre of gravity; and it may also have three independent rotations about three independent axes passing through the point so fixed. If the rigid body is not free to rotate, or if (as in the case of the smooth spherical molecules imagined by Maxwell) there is no force acting which tends to produce rotation, the number of degrees of freedom may be considered as reduced to three, the three co-ordinates of the centre of gravity being then sufficient to define the state of the body completely. In particular, a molecule shaped like a dumb-bell may be considered to have but five degrees of freedom, if it is so smooth that collisions cannot set it in rotation about its axis of symmetry. The number of degrees of freedom of a rigid body is six, in the most general case; but if two or more rigid bodies be joined together by hinges, or by any other analogous mode of connection that will allow of relative motion between the components, the number of degrees of freedom of the system so formed becomes greater than six. Thus a system composed of N straight rods, connected together by flexible joints at their ends, has (2N + 3) degrees of freedom.

Boltzmann's form of the kinetic theory may now be stated as follows: Let there be a gas composed of any number of sets of molecules, such that the molecules belonging to each set are exactly like one another, though a molecule belonging to one set may be totally unlike a molecule belonging to another set. Let these molecules have any number of degrees of freedom (which number of degrees may be different in the different sets), and let them be acted upon by parallel forces (such as gravity), or by forces tending toward fixed centres, or by internal forces (that is, forces acting within the individual molecules, between their parts). Let all the molecules be very small in comparison with the total space they occupy, so that the chance of their colliding three or more at a time is practically nothing. Moreover, let them be very numerous and let them be perfectly elastic, and let them be smooth, so that when they collide the only force tending to make them rotate is that due to normal impact. Let them be set in motion among one another with any distribution of velocities; and let them be hard, but not infinitely so — the force called into play during collision being very great, but not necessarily infinite (as it would be if the hardness were infinite); and let the duration of a collision be exceedingly short, yet not necessarily zero. Then Boltzmann reaches the following conclusions: (1) After a short time, the law of distribution of positions and velocities in each set of the molecules will be precisely the same as it would be if all the other sets were absent; so that each set behaves as a vacuum to all the rest, so far as the distribution of velocities and the density of aggregation of the molecules in any given region are concerned. (2) The law of distribution of the velocities of translation in each set is the same as that deduced by Maxwell for spherical molecules. (3) The average kinetic energy *of translation* of the molecules of any one set is equal to the average kinetic energy *of translation* of any other set.. (4) The total kinetic energy of each set of molecules (including that due to translation, rotation, etc.) is divided up equally among the different degrees of freedom of that set. This last proposition is undoubtedly one of the most remarkable ever enunciated with regard to molecules and it appears not to have met with unqualified acceptance among mathematicians, though there are many experimental facts which tend to show that it is at all events a good approximation to the truth.

Although Maxwell and Boltzmann agree that the percentage of molecules that have velocities much larger than the average velocity is very small, it must be remembered that according to either form of the kinetic theory there is always a certain number of molecules that have velocities of any assigned magnitude whatever; and Stoney has pointed out that if this conclusion is really sound, one consequence of it is, that the earth must be continually losing molecules of its atmosphere by their flight from the upper layers of the atmosphere, into space. A molecule of air escaping into space with a verticle velocity greater than about seven miles per second would possess sufficient momentum to carry it beyond the range of the earth's attraction forever. The loss of air that takes place in this manner is probably very gradual, but it is doubtless real, and in the course of ages it may result in the entire dissipation of the earth's atmosphere into the depths of space. It has been suggested that the absence of an atmosphere about the moon, and the apparent rarity of the atmosphere of Mars, may be due to this cause; the action having been more rapid in the cases of these two bodies, because their attractive power is smaller, and hence a larger proportion of atmospheric molecules would have the critical speed necessary to enable them to pass off into space.

It has been stated, above, that Boltzmann found that in a gaseous mixture each set of molecules would assume the same distribution that it would have if it existed in the given space alone. This corresponds to the known experimental fact that gases of different kinds will diffuse into one another, so as to eventually form a homogeneous mixture. When a bottle of some strong-smelling gas, like ammonia, is opened in a room containing still air, we cannot perceive the odor at any considerable distance until quite a time has elapsed. The molecules of the ammonia vapor are indeed moving with high velocities, but they continually strike against air molecules, rebounding from them in such a manner that in any given region there are almost as many of them returning toward the bottle as there are going away from it. They are forced to describe zigzag lines which are so very crooked that by the time an ammonia molecule has reached a point actually 10 feet distant from the bottle, it has in all probability traveled many miles. But eventually the ammonia molecules and the air molecules become thoroughly mixed, just as the kinetic theory predicts. Boltzmann's theory also teaches that in a gaseous mixture the distribution of velocities is the same in each set of molecules as it would be if that set existed in the same space alone. If the explanation of gaseous pressure suggested at the beginning of this article is correct, it follows that each constituent of the gaseous mixture will contribute to the total pressure that the gas exerts against the vessel containing it, by an amount equal to the pressure that this constituent would exert if it existed in the same space by itself. This corresponds to the known law of Dalton with regard to gaseous mixtures. — the law which states that in a gaseous mixture the total pressure is equal to the sum of the partial pressures due to the several constituents separately.

It may be shown that the average kinetic energy of translation of the molecules of a given mass of gas is sensibly proportional to the absolute temperature of the gas. This being admitted, it is easy to understand the reason for Boyle's law. (See Liquefied and Compressed Gases). For so long as the temperature of the gas remains constant, the average velocity of translation of the molecules also remains constant, and therefore the average effect of the blow that a molecule strikes against the walls of the containing vessel is also constant. But the pressure, in this case, will vary in direct proportion to the number of blows that the molecules strike against a unit area of the walls in a given time, and this will also vary in direct proportion to the number of molecules that a cubic inch of the gas contains. We see, therefore, that if the temperature of a gas remains constant, the pressure that the gas exerts will vary directly with the density of the gas; or, to state the same fact in another way, the pressure will be inversely proportional to the volume of the gas, which is Boyle's law.

Avogadro's law may be derived in a somewhat similar manner. Thus let P be the pressure that a gas exerts against a unit area of the containing vessel, let N be the number of molecules that it contains, per unit of volume, and let K be the average kinetic energy of translation of its molecules. Then the kinetic theory shows that the pressure of the gas can be expressed in the following manner: $P = \frac{2}{3} NK$. If two different kinds of gas are to be compared, we may conveniently distinguish the values of P, N and K that relate to the separate gases by using the subscripts 1 and 2. Then for one gas we shall have $P_1 = \frac{2}{3} N_1K_1$, and for the other $P_2 = \frac{2}{3} N_2K_2$. If the pressure is the same in both gases, we have $P_1 = P_2$, and it is easily seen that this involves the equation $N_1K_1 = N_2K_2$. Now, if the temperatures of the two gases are also equal, the average kinetic energy of translation is likewise the same in both gases; that is, $K_1 = K_2$. Taking this into account, we see that it follows that $N_1 = N_2$; or, in other words, when two gases have the same temperature and the same pressure, they also contain the same number of molecules per unit of volume; and this is Avogadro's law.

Knowing the mass of a given volume of a gas, and the pressure that the gas exerts against the boundaries that confine it, we may calculate the average speed that the constituent molecules of the gas must have, in order to produce the observed pressure. The formula by which the calculation is effected need not be given here, but some of the results are of interest. Thus it is found that at 32° F. the molecules of the more familiar gases have the following average velocities, in feet per second: Hydrogen, 5,571; oxygen, 1,394; nitrogen, 1,488; carbon monoxide, 1,491; carbon dioxide, 1,189. At higher temperatures, the velocities are greater, being proportional, for any one gas, to the square root of the absolute temperature.

A very important application of the kinetic theory of gases relates to the ratio of the specific heats of a gas. Boltzmann's theory shows that if the specific heat of a gas at constant pressure be divided by its specific heat at constant volume, then the quotient can be expressed in the form $1 + \frac{2}{n}$, provided the effects of such forces as may exist between the different molecules of the gas are negligible, n being the number of degrees of freedom of the molecules of gas under consideration. This equation, it will be seen, affords a means of ascertaining the number of degrees of freedom of the molecule of a gas, by setting the foregoing expression equal to the observed value of the ratio of the specific heats, and then solving the equation for n. By this method, it has been inferred that the molecules of hydrogen, nitrogen, oxygen and carbon monoxide have each five degree of freedom; for the ratio of the specific heats of these gases approximates closely to 1.4, which is the value of the foregoing expression for $n = 5$. If the molecules of a gas were really smooth spheres,— so smooth that they could not be set in rotation by their collisions,— then we should have $n = 3$, and hence the ratio of the specific heats would be 1.667, a value which is actually observed in the cases of argon, helium, mercury vapor, cadmium vapor, and a few other substances. Hence it is inferred that argon and helium are elementary bodies; because it is difficult to conceive of a compound body behaving, so far as collisions are concerned, as though its molecules were smooth spheres; and if they had any other shape, it would be necessary to admit that they have at least five degrees of freedom (since it is impossible for any body in free space to have four degrees of freedom), and this would reduce the calculated value of the ratio of the specific heats to 1.400, a value which it is apparently impossible to reconcile with the results of direct observation.

Most of the results of the kinetic theory, as given above, involve the assumption that the effects of the mutual attractions that may exist between the individual molecules of a gas are small, on the whole. The forces, when they exist, may be great; but we assume that under ordinary circumstances the radius of sensible action of these forces is small in comparison with the length of the average distance that the molecules travel, between successive collisions. When, by reason of the gas being greatly compressed, this assumption becomes of doubtful validity, the foregoing conclusions become correspondingly weakened. The average distance that a molecule travels, between successive collisions, is known as its «free path»; and numerical estimates of the length of the free path have been obtained, by methods which cannot be given in the present article. Thus the free paths of some of the more familiar gases are as follows (expressed in ten-millionths of an inch), the gases being supposed to be at 32° F., and under ordinary atmospheric pressure: Oxygen, 38; nitrogen, 36; hydrogen, 67; carbon monoxide, 36; carbon dioxide, 25. When the density of a gas is diminished, the average free path of the molecules increases in direct proportion to the decrease in density. Thus in the high vacua that prevail in X-ray tubes, the mean free path may be measured in inches; the free path for hydrogen, for example, being about 6.7 inches, when the density of the gas has been reduced to the millionth of the normal density at 32° F. and atmospheric pressure.

The whole kinetic theory of gases is likely to be profoundly modified in the near future, when physicists have learned more about the «electron» (q.v.), which is now commonly regarded as the foundation unit in molecular architecture. For further details concerning the subjects touched in this article, consult Boltzmann, ‹Vorlesungen über Gastheorie›; Meyer, ‹Kinetic Theory of Gases›; Risteen, ‹Molecules and the Molecular Theory of Matter›; Watson, 'Kinetic Theory of Gases'; Tait, 'Foundations of the Kinetic Theory of Gases.' See also CRITICAL POINT; LIQUEFIED AND COMPRESSED GASES; MATTER, PROPERTIES OF; MOLECULAR THEORY; THERMODYNAMICS.

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GASES, Liquefaction of. It has also been long known that most solids can be transformed into liquids by the application of heat, and that many liquids can also be transformed into vapor by a further addition of heat. Conversely, it was known that certain aëriform substances, such as steam, can be converted into liquids by the mere abstraction of heat. It was believed, however, that an essential difference exists between gases and vapors, vapors being condensible to the liquid form, while gases were believed to be permanently aëriform, and not condensible by any experimental means at our disposal. In the early part of the 19th century the validity of this distinction came to be doubted, and Faraday, at the suggestion of Davy, undertook the systematic study of the question. He succeeded in reducing to the liquid form quite a number of gases that had previously resisted liquefaction. His general method consisted in generating the gas in large quantities in a limited space, so as to produce a very high pressure, under the influence of which (when the experiment was successful) the gas passed into the liquid state. The most convenient way of carrying out this experiment is to make use of an inverted U-shaped glass tube, one of whose legs contains a chemical preparation suitable for the generation of the gas in question, while the other end dips into a freezing mixture; the tube being hermetically sealed. If cyanide of mercury be heated in one of the legs of a tube of this kind, for example, cyanogen gas is generated in such quantities that the pressure causes a large part of it to condense in the chilled end of the tube. Chlorine was liquefied by Faraday in this manner in 1823. Shortly afterward Thilorier succeeded in solidifying carbon dioxide by the combined application of intense cold and great pressure, and Cagniard de la Tour, Regnault, Natterer, and many other experimenters, improved the methods in use with the result that many of the gases that had been previously regarded as non-condensible were reduced to the liquid form. Oxygen, hydrogen, nitrogen and some few other gases still resisted all attempts at liquefaction, however, and these were still called «permanent gases,» although the conviction had forced itself upon physicists that all gases could be conquered, if the necessary conditions of success could be discovered. The subject was in this state when Andrews undertook his classical study of the phenomena of liquefaction of carbon dioxide. In 1863 he made the following announcement: «On partially liquefying carbonic acid by pressure alone, and gradually raising at the same time the temperature to 88° F. (31° C.), the surface of demarcation between the liquid and gas became fainter, lost its curvature and at last disappeared. The space was then occupied by a homogeneous fluid, which exhibited, when the pressure was suddenly diminished or the temperature slightly lowered, a peculiar appearance of moving or flickering striæ throughout its entire mass. At temperatures above 88° F. no apparent liquefaction of carbonic acid, or separation into two distinct forms of matter, could be effected, even when a pressure of 300 or 400 atmospheres was applied.» It appeared, therefore, that a certain temperature exists, above which carbon dioxide cannot be liquefied by any pressure whatever; and this discovery was soon verified in the case of other gases. The temperature in question is known as the «critical temperature» of the gas under experiment. (For its numerical values in the cases of the more important gases, see CRITICAL POINT). The reason that oxygen, nitrogen and hydrogen resisted previous attempts at liquefaction, even when the pressure was pushed to 3,000 atmospheres, was that the critical points of these gases are very low indeed,— far below any temperature at which the attempt at liquefaction had been made. The problem of liquefying the so-called «permanent gases» was, therefore, resolved into the production of exceedingly low temperatures. One means for the production of such temperatures was given by Thilorier, who showed that by mixing solid carbon dioxide with ordinary ether, a temperature as low as 165° F. below zero may be attained. The cold produced by the expansion of the gases themselves has also been utilized for the production of the necessary degree of cold, and in the best modern forms of apparatus the gas, after being cooled by its own expansion, is furthermore caused to circulate about the pipes that are conducting fresh supplies of gas to the point at which the expansion takes place. In all cases, every care is taken to make use of any process or device which will lower the temperature of the gas; and by the strictest attention to this general principle, it has been found possible to liquefy every known gas except possibly one or two of the rare gaseous elements recently discovered in the atmosphere. It is highly probable that these will also succumb, when they can be obtained in sufficient quantity to be treated by the same methods that have yielded success in the case of so obdurate a gas as hydrogen. Hydrogen was first liquefied, in quantity, by Dewar, in 1898. Consult Hardin, 'Rise and Development of the Liquefaction of Gases.'

GASES IN MINES AND COAL. Gases of several kinds are given off by rocks and especially by coal in mining. Some of these gases are poisonous and some are explosive so that fresh air has to be forced through most underground workings to ventilate them. More or less oxygen is also consumed and carbonic oxide is produced by men and animals in the mine, the decay of timbers, explosives, oxidation of coal, etc. Ordinarilv the principal gas that emanates from freshly cut coal is methane, CH_4, popularly known as marsh gas, which when mixed with air is the highly explosive «fire damp.» The following is a list of the principal mine gases, their composition and specific gravity.

PRINCIPAL MINE GASES.

NAME	Composition	Specific Gravity
Methane	CH_4	.56
Carbon dioxide	CO_2	1.53
Carbon monoxide	CO	.97
Olefiant (Ethene)	C_2H_4	.98
Ethane	C_2H_6	1.04
Hydrogen sulphide	H_2S	1.19
Oxygen	......	1.10
Nitrogen	......	.97
Hydrogen	......	.07

Oxygen and nitrogen in mines are mostly from air, but considerable oxygen is absorbed by the coal, lowering the oxygen ratio from its normal one (approximately 79 per cent nitrogen and 21 per cent oxygen). Carbon dioxide occurs in moderate amounts in most mines, but in some cases and locally it is present in large volume. Carbon monoxide is rarely an ingredient of the gases in coal and when present in mines it is generally a product of incomplete combustion, whether that of explosives, coal or wood, or explosion of gas or coal dust. It is a colorless, odorless gas slightly lighter than air, strongly explosive and extremely poisonous.

All coal contains in its pores and crevices some of the inflammable gas methane, which is given off when the coal is in the ground, during mining and in diminished volume for a long time after mining. The amount in the coal varies greatly in different beds and localities, and in some mines the amount is so small that they are classed as «non-gaseous.» In some such cases most of the original gas has been lost, especially in the shallower workings. In the anthracite region of Pennsylvania there are several mines giving off 2,000 cubic feet of methane a minute, or nearly 3,000,000 cubic feet a day, which is brought to the surface by the ventilating system. This would be sufficient to supply heat and illumination for a city of 100,000 inhabitants. It is estimated that the total outflow of the gas in the Northern Anthracite Basin alone is 31,000 cubic feet a minute, 43,640,000 cubic feet or 1,000 tons a day.

At ordinary temperatures most coal yields at least an equal volume of gas or 20 cubic feet to the ton. Some coal yields five times as much as this and unusual samples have yielded at the rate of 150 cubic feet per ton of coal. The proportion of methane in the gases also varies but from most coal mines it is in excess of 75 per cent, the remainder being carbon dioxide, oxygen and nitrogen.

Origin.— Methane in coal undoubtedly is a product of the decomposition or molecular rearrangement of organic matter during its transformation into coal by putrefactive bacilli. The process may have continued for some time but is now no longer in progress in the coal. Possibly, however, the diminution of pressure in the coal by erosion of overlying strata or even by mining may effect disassociation of some as yet unrecognized intermediate compounds with resulting emanation of more or less additional methane.

Probably different degrees of putrefaction had much to do with variations in the amount of methane in coal. Renault has studied the process in detail and discovered remains of the various organisms which cause putrefaction in vegetal accumulations. It was found that the process varied with the nature of the materials and their rate of deposition, and accordingly the resulting gases vary in character and proportions. The stage of progress when the vegetal matter was buried by sand or mud and the nature of the cover had great influence. Naturally all these conditions varied from place to place so that the variation in the volume of methane now found in the coal was largely caused early in its history. Of course there has been more or less subsequent escape of the gas, especially where overlying strata are porous or have been thinned by erosion. Ordinarily there is more methane in anthracite than in bituminous coal and if this gas was developed when the coal was formed it is a mistake to suppose that in anthracite most of the volatile matter has been «baked out» and escaped through porous rocks and joints. It is impossible to conceive of the loss of the heavy hydrocarbons of the so-called «volatile matter» and the retention of several volumes or any of the highly volatile methane. As shown above it is most improbable that any notable amount of the methane developed after the «metamorphism.»

Fire Damp.— The term fire damp is applied to mixtures of methane and air in which the proportion of the former is from 4 to 30 per cent. Pure methane is not explosive because a large amount of oxygen is required for its combustion, and ordinarily when its proportion falls below 5 per cent the danger of explosion is passed. A proportion of 9½ per cent of methane causes the most violent explosion and Barrell and Siebert have found that mixtures containing less than 5.5 per cent or more than 12.8 per cent will not explode. The limit of inflammability is near 30 per cent, the mixture burning quietly between this proportion and explosibility (12.8 per cent). However, proportions of methane above 4 per cent are highly dangerous because a slightly increased rate of emanation might bring the proportion up to the explosive figure and mixtures containing more than 12.8 per cent may quickly become diluted with sufficient air to make them explosive.

The proportion of methane in the air in a mine depends not so much on the amount given off by the coal as on the volume of air used for ventilating the workings. Therefore for comparisons it is best to consider the volume of methane in a unit of time. This depends upon the amount of coal mined but with notable variations from place to place and in different mines and districts. There has been considerable discussions as to what constitutes a gaseous mine but most authorities agree that 2 per cent of methane in the return air places the mine well within the category, especially if there is liability of a sudden increase. In certain mines in the northern anthracite basin of Pennsylvania with total discharge of 2,000 to 3,000 cubic feet of methane a minute, the percentage approaches 2. The return air from a group of mines in Prussia carried from .13 to 1.5 per cent of methane and some of the more gaseous ones gave off 256,500 to 897,600 cubic feet of that gas a day. Some Austrian mines carried from .68 to 1.90 per cent of methane in their total returns, Russian mines .13 to 2.92 per cent and mines in Scotland .05 to .5 per cent.

Mode of Entry.— Gas escapes from coal mostly through pores and minute fissures but in places «feeders» or «blowers» occur which yield large volumes of gas. These are not always in the most gaseous mines. A persistent blower in the Pelham mine in England in 1847 for a while discharged 47,000 cubic feet a minute. Some blowers continue for many years. The gas is mostly methane with 5 to 20 per cent of nitrogen and a small amount of carbon dioxide. In a few mines in Europe blowers of carbon dioxide occur. Sometimes in the course of mining and especially through «runs» or «falls» of coal, «squeezes» or roof caving, large bodies of gas come suddenly into a mine and such "outbursts" have caused some very serious explosions. In places gas accumulates in pockets and this is rapidly liberated when large volumes of coal are shattered. Many runs of coal are caused by gas pressure. An outburst in a mine six miles west of Pottsville, Pa., liberated a body of gas estimated at 50,000 to 200,000 cubic feet; at Agrappe Colliery, Belgium, in 1879 an outburst of 85,000 cubic feet caused the death of 121 miners; at Bességes, Belgium, in 1890 an outburst of 28,000 cubic feet exploded killing 131 miners, the outflow continuing 12 hours. At Morrissey in British Columbia in 1904 an outburst threw out 3,500 tons of coal with emission of about 5,000,000 cubic feet of gas. At Abercarne mine in south Wales the face blew out and about 1,000,000 cubic feet of gas were emitted. The great squeezes at Pittston, Pa., in 1904 and at Warrior Run, near Wilkes-Barre, Pa., two years later, gave off vast volumes of explosive gas. It is estimated that 357 of the explosions in Belgium mines from 1850 to 1908 with large fatalities were due to gas. Doubtless some of the great dust explosions in coal mines have been started by ignition of a gas outburst.

Volume.— The amount of methane given off in mining coal differs greatly in various regions and mines and parts of mines. In 23 mines in the Saarbrucken Basin, Germany, it ranged from 16 to 1,060 cubic feet to the ton of coal mined or from ½ to 30 times the volume of the coal and in one case the volume of gas was 2,160 cubic feet to the ton (a ton of coal is about 20 cubic feet). The total emanation from these 23 mines ranged from 8,870 to 732,566 cubic feet a day, with a yearly total of about two and one-quarter billion cubic feet or 44,000 tons. Certain mines near Wilkes-Barre, Pa., producing about 2,000 tons of coal a day each, give off 2,000 to 3,000 cubic feet a minute or 1,500 to 2,500 cubic feet of methane to the ton of coal mined. Other mines in the same basin with equal output gave off only 15 to 75 cubic feet to the ton of coal produced.

In gaseous districts in Austria the methane emanation averaged 7,479 cubic feet to the ton of coal extracted or 370 cubic feet of the gas to a cubic foot of coal, and the average in the less gaseous mines was 26 cubic feet to the ton. The Prussian Commission found 30 to 120 cubic feet to the cubic foot of coal removed and in one district the amount was 14 cubic feet. It was found by Darton that in the northern anthracite coal field of Pennsylvania the average amount was 140 cubic feet and in mines in the bituminous field of central Illinois the amount ranged from ½ to 10 cubic feet of gas to the cubic foot of coal removed. Generally the amount is less in old mines because much of the gas has escaped. In most cases also the cessation of mining on Sundays and other times showed material diminution in the gas emanation. Some comparisons made after a shut down of one month caused by a strike in Pennsylvania and Illinois mines showed a marked decrease in parts of most mines but in a few places there was no change or a slight increase. The general decrease in a group of Illinois mines was 32 per cent.

Pressure.— The gas confined in coal beds must exert a pressure proportionate to its relative volume and as the volume is variable the pressure varies accordingly. Observations made with tubes sunk in the coal faces in various mines showed pressures from almost inappreciable amounts to several hundred pounds to the square inch. The cause of the variation is difficult to understand. Pressure is manifested in many places by the disposition of the coal to break out of the face in mining and often men are killed by this cause. Naturally, however, some of the evident pressure in the face is due to stress from the roof and other sources. The pressure observations gave varied results. In a group of English mines the pressures ranged from 28 to 461 pounds to the square inch, in Belgium mines the range was 187 to 555 pounds, in Liévin, France, 64 to 96 pounds while at Saint Etienne it ranged from ½ to 44 pounds and in Austria 82 to 142 pounds. In a mine near Wilkes-Barre, Pa., a pressure of 45 pounds was observed and in several mines in central Illinois the pressure ranged from a few ounces to 33 pounds. At most places where the pressures were notable several days were required for the maximum amount to be manifested in the gages used in the tests. The pressure shown was seldom closely related to the amount of gas escaping. In a given locality the highest pressure was usually found in the deepest test holes and compactness of the coal has much influence because the gas escapes from the coal near the face and the pressure rapidly declines, especially in the more permeable coal. It is well known that considerable gas escapes through permeable rocks adjoining the coal, in some areas reaching the surface of the ground. Much gas also flows into the mine workings by this means.

Volume in Coal.— The volume of gas in coal which has been removed from the mine varies greatly. Samples heated to 212° F. gave the following amounts:

VOLUME OF GASES GIVEN OFF BY VARIOUS COALS AT 212° F.

KIND OF COAL	Volumes	Constitution	
		CH_4 per cent.	CO_2 per cent.
English, bituminous....	.32– .82	5–36	.8–6.00
" semi-bituminous	.99–5.07	5–13	.3–1.00
" anthracite.....	7.50–8.11	2– 5	....
Ryhope district........	11.00	16	1
German, various mines..	.4–1.9	60–94	....
" Saarbrucken...	2.5	84	16
Belgian...............	2.5	43–87	....

VOLUMES OF GASES GIVEN OFF BY AMERICAN COALS AT ORDINARY TEMPERATURES IN SEVERAL MONTHS.

LOCALITY	Volumes	Relative volumes	
		CH_4	CO_2
Monongah, W. Va......	.90	....	....
Nanticoke, Pa.........	4.00	....	....
Pocahontas, Pa.........	.05	.04	.01
Harrisburg, Ill........	1.13	1.08	.05
Benton, Ill...........	1.95	1.82	.13
Sheridan, Wyo.........	.55	.18	.37
Rock Springs, Wyo.....	.09	.07	.02
Hanna, Wyo...........	.25	.22	.03
Connellsville, Pa.......	.17	.16	.01

These had all lost much gas in mining.

Condition.—As the volume of gas in coal is in most cases greater than that of the coal and vastly more than that of the interstices or pores, its physical condition is problematical. There must be condensation under such high pressure. When coal is mined and especially when it is crushed, a large proportion of the gas escapes rapidly but much time is required for the complete liberation of the gas as its tension decreases. Chamberlin found on crushing coal in a vacuum only one-quarter as much gas was given off in the process as was given off in vacuum in six months following.

It would seem that powdering the coal would open all of its pores and liberate practically all the gas, but this is not the case. It was found that even under an applied pressure of 75 pounds to the square inch coal samples continued to give off gas. No relation has been found between the proportion of gas and the texture of the coal or of the components of the coal as indicated by chemical analyses. Coals highest in «volatile constituents» are not highest in methane.

It has been shown that methane and other gases escape from coal while it lies in the ground, while it is being mined and for a long time after it is mined. The rate of escape varies with different coals and the proportion of methane in the admixture also varies, but in general in the laboratory it is found that the methane is given off somewhat more slowly than the other gases. Samples under different test conditions gave off the gases very unevenly. Crushed samples of bituminous coal from Monongah, W. Va., gave off 1.5 volumes of methane rapidly and then continued to give off a gradually diminishing amount for six months, one-third additional volume coming out in that time. Fine pulverization hastens the emanation but in most cases did not add to the ultimate total.

Relation to Weather and Earth Movements.— It is an old and deeply-seated idea that there is close connection between the weather and the amount of fire damp in mines, and miners generally regard increased gas emanation as an indication of the approach of stormy weather. The idea has been prevalent also that explosions in mines are more frequent at times of low atmospheric pressure. Sir F. Abel has shown that this is not the case for in explosions from 1875 to 1885 involving the loss of 2,729 lives only 17.4 per cent of the mortality was at a time when the barometric pressure was below the average and half of the explosions occurred when the pressure was increasing. It is now known, however, that many of the explosions were caused by dust and had no relation to increase of gas in the mine. Diminution of atmospheric pressure undoubtedly affects the liberation of gas from coal surfaces and especially from old workings and crevices where gas has accumulated, but it cannot materially affect the gas under high pressure in the body of the coal. Investigations in English, French, Prussian and Austrian mines all showed increase of methane in the returns when atmospheric pressure diminished, especially if the change was rapid, but in nearly all the tests there were extensive old workings containing more or less gas. Tests with coal samples showed no relation up to a diminution of pressure amounting to one and one-half inches of mercury.

It has been claimed that earthquakes, sunspots and other natural disturbances affect the emanation of gas in coal mines but investigation has not shown any such relation. G. H. Darwin has shown that variations in atmospheric pressure cause up-and-down movements of the earth's crust which may amount to several inches in vertical amplitude. These might cause slight cracking in some places and so affect gas emanation. From a consideration of a large amount of evidence the author believes that ordinary earth movements do not materially affect the emanation of methane in mines unless possibly to precipitate an outburst that is about ready to take place; ordinarily a blast in a nearby chamber would cause much more local movement than an average earthquake.

Poisonous Gases.— The physiologic effect of gases in mines varies greatly. Any air in which the oxygen content falls below 7 per cent will not support human life and half the normal amount or 10½ per cent is dangerously low, so that whenever air is mixed with an excess of inert gases it may prove fatal. Methane and carbon dioxide are probably not toxic and perhaps no more deleterious than the harmless nitrogen, but their proportion may become so great in the mine air that they will not support human life. It is claimed by some physiologists that carbon dioxide has slight toxic effect but this is by no means proved. Carbon monoxide, however, which is produced in certain amounts in the ignition of fire damp and coal dust, in explosions and by mine fires is highly poisonous. It is the toxic agent in the afterdamp resulting from explosions that kills many miners and is very dangerous to those endeavoring to rescue the men imprisoned in the mine. Air containing a very small proportion of carbon monoxide will cause death, especially if the proportion of the oxygen is diminished. The amount that can be endured by a person depends mainly on his vitality and the length of time he breathes the gas, but no one can survive more than a few minutes in air containing one-half of 1 per cent. The effect is cumulative and half this proportion would be fatal if breathed for a long time. No gas masks will satisfactorily remove the gas although it is absorbed by blood and decomposed by certain copper compounds under favorable conditions. Removal from the bad air and vigorous long-continued artificial respiration, especially with oxygen, may save a person who has succumbed, but the chances of recovery are much less than in suffocation by carbon dioxide or other inert gas.

Bibliography.—Arnould, G., 'Étude sur les dégagements instantanés de Grisou dans les mines de houille du bassin Belge' (Ann. Trav. Pub. Belgique, Vol. XXXVII, pp. 1–108, 1880); Austrian Fire Damp Commission Publications, Abstract Fed. Inst. Min. Eng. (Vol. III, pp. 531–550, 1892); Barker, P., 'Occluded Gases in Illinois Coals' (Ill. Geol. Survey Bull. 14, 1908); Beard, J. T., 'Mine Gasses and Explosions' (1908); Bedson, P. P., 'Report of the Prussian Fire Damp Commission' (Trans. Fed. Inst. Min. Eng., Vol. III, pp. 1105–50, Vol. IV, pp. 631–680, Vol. V, pp. 500–554, 1892–94); Behrens, 'Beitrage zur Schlagwetterfrage' (Oest. Zeitschr. Berg-Huttenwesen, Vol, XLV, 1897);

Burrell, G. A., and Siebert, F. M., 'Inflammable Gases in Mine Air' (Bureau of Mines Technical Paper, 39, 1913); Chamberlin, R. T., 'Explosive Mine Gases and Dusts' (U. S. Geol. Survey Bull. 383); Chesneau, G., 'De l'etude des mouvements de l'ecorce terrestre au point du vue de leur rapports avec les dégagements de produits gazeux' (Annales des mines, ser. 8, Vol. IX, pp. 207–281, 1886, Vol. XIII, pp. 389–428); Darton, N. H., 'Occurrence of Explosive Gases in Coal Mines' (Bureau of Mines, Bull. 72, 1915); Ghysen, H., 'Quelques considerations sur les dégagements instantanés de grisou' (*Review Univ. des Mines*, ser. 3, Vol. LIX, pp. 1–61, 1902); Hilt, C., 'Bericht über Versuche betreffend den Einfluss des wechselnden Luftdruckes auf die Entwickelung des Grubengasses' (Auftrage der Preuss. Schlagwetter Commission, Zeitschr. Berg-Hutten-Salinenwensen, Vol. XXXIV, pp. 72–90, 1886); Kohler, G., 'De l'influence des variations de la pression atmosphérique sur les dégagements de grisou' (Bull. de la soc. l'indus. min., ser. 3, Vol. I, pp. 627–655); Le Chatelier, H., 'Le Grisou' (Translation Col. Eng., Vols. XIII and XIV); Mallard, E., 'Experiences sur la pression du grisou dans la houille' (Annales des Mines, ser. 8, Vol. I, pp. 530–551, 1882); Maquet, A., 'Mesures des pression du grisou dans Beaulieusart du Fontaine l'Eveque' (Ann. Trav., pub. Belgique, Vol. XLIV, pp. 405–451, 1886); Milne, J., 'On Earth Pulsations and Mine Gas' (Trans. Fed. Inst. Min. Eng., Vol. V, pp. 203–230, 1893); Morin, L., 'De l'influence des variations de la pression atmosphérique sur les dégagements de grisou' (Annales des Mines, ser. 10, Vol. XVI, pp. 285–437, 1909, and *Eng. and Min. Jour.*, Vol. XC, pp. 565–568); Parr and Barker, 'The Occluded Gases in Coal' (Univ. of Ill., Bull. 32, 1909); Porter and Ovitz, 'The Escape of Gas from Coal' (Bureau of Mines, Tech. Paper 2, 1911); Simon, A., 'Expériences faite aux mines de Liévin' (Ann. des Mines, ser. 9, Vol. VIII, pp. 219–231, 1895); Wood, L., 'Experiments Showing Pressure of Gas in Coal' (Trans. N. of Eng. Min. Eng., Vol. XXX, pp. 163–256, 1880–81).

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GASES IN ROCKS. Rocks contain small amounts of various gases; some minerals have minute cavities containing liquid and gaseous matter, usually both. Meteorites contain gas, some of them in large relative volume. Many igneous rocks when subjected to high temperature in a vacuum give off several times their volume of gas. Chamberlin has determined the volume and proportion of gases in many samples of rocks of various classes and ages. The tests were made by heating the pulverized rock in a vacuum. The accompanying table gives averages of the results.

Among igneous rocks classified by age the oldest rocks generally contained the most gas, the smallest amount being in recent lavas (.60 volume). Fine grained igneous rocks yielded more gas than the more coarsely granular ones. In the sedimentary rocks tested there was less difference in relation to age. The condition of these gases is somewhat in doubt. Small amounts are in minute cavities, some other portions are doubtless occluded, and from some rocks possibly considerable of the gas given off is due to chemical reaction at the high temperature. Consult Chamberlin, R. T., 'The Gases in Rocks' (Carnegie Inst. of Washington, Publication No. 10, 1908).

Analyses of Gases from Rocks and Meteorites.
(Relative Volumes).

Type of rock	No. of Analyses	CO_2	CO	CH_4	H_2	N_2	H_2S	Total
Schist, basic	2	4.06	0.19	0.05	3.44	0.13	0.00	7.87
Diabases and basalts	14	3.96	.44	.12	2.54	.11	.19	7.36
Gabbros and diorites	11	2.31	.13	.07	2.09	.11	.02	4.73
Granites and gneisses	19	1.47	.22	.05	1.36	.09	.00	3.19
Andesites	7	1.86	.18	.06	.20	.09	.00	2.39
Syenites	4	.18	.07	.05	.91	.04	.00	1.25
Rhyolites	4	.69	.05	.02	.06	.05	.00	.87
Shales (non-bituminous)	3	3.72	.45	.11	.97	.18	.00	5.43
Sediments (metamorphosed)	13	.77	.22	.05	1.52	.05	.57	3.18
Sandstone and quartzite	12	.29	.11	.02	.17	.08	.02	.69
Meteorites, stony	12	3.77	.24	.20	.50	.09	.00	4.80
Meteorites, iron	9	.21	.67	.02	1.67	.24	.00	2.83

GASH VEIN. See Vein.

GASKELL, Elizabeth Cleghorn Stevenson, English novelist: b. Chelsea, 29 Sept. 1810; d. Alton, Hampshire, 12 Nov. 1865. She was brought up by an aunt at Knutsford in Cheshire, where she spent the greater part of her early life. This town is said to be the original of the village in her story of 'Cranford,' described as inhabited exclusively by maiden ladies and widows of limited means. She married in 1832 the Rev. William Gaskell (q.v.), a Unitarian clergyman then recently appointed minister of Cross Street Chapel, Manchester. Her first work, 'Mary Barton,' appeared in 1848. The *Athenæum* says it raised the Lancashire dialect almost to the level of the broad Doric used by Scott in his northern novels. In this, as in most of her works, Mrs. Gaskell appears as a social reformer. Her moral and economical theories may be questioned, but as a writer of fiction she wields artistic and dramatic powers of a high order. 'Mary Barton' represents the struggles formerly so rife in Lancashire, and which have since passed in new phases and into other quarters, between workmen and employers. 'The Moorland Cottage' appeared in 1850; and in 1853, her next novel, 'Ruth,' which aims a distinct blow at the common moral judgments of society. The tale is powerfully told, but will hardly satisfy a dispassionate reader of the soundness of Mrs. Gaskell's moral theories. Her later works include 'Cranford' (1853), an English classic, the popularity of which is constantly increasing; 'North and South' (1855); 'Sylvia's Lovers' (1860); 'Cousin Phillis' (1865); 'Wives and Daughters' (1866). In 1857 appeared a 'Life of Charlotte Bronte,' of which the *Athenæum* observed: «As a work of art we do not recollect a life of a woman by a woman so well executed.» Consult Chadwick, E. A., 'Mrs. Gaskell, Haunts, Homes and Stories' (New York 1911); Shorter, C. K., 'Mrs. Gaskell' (London 1904).

GASKELL, Walter Holbrook, English scientist: b. Naples, Italy, 1847; d. 1914. He received his education at Cambridge University and studied medicine at the University Hospital and also at the University of Leipzig. He was appointed lecturer in physiology at Cambridge in 1883, and six years later was made Fellow of Trinity Hall. He received a gold medal from the Royal Society for his investigations of the nervous system. He became known internationally for his theory concerning the central nervous system of vertebrates which he claims is derived from a union of the nervous system of an ancestral crustacean form with the alimentary canal. He became head of the physiological department of the British Association for the Advancement of Science in 1896.

GASKELL, William, English Unitarian clergyman: b. Latchford, near Warrington, Lancaster, 24 July 1805; d. Manchester, 11 June 1884. He was graduated from the University of Glasgow in 1824; studied theology at Manchester College, York, in 1825–28; was junior minister of Cross Street Chapel, Manchester, from 1828, and senior minister from 1854. In 1840–46 he was secretary to Manchester New College, and in 1846–53 professor there of English history and literature. He also taught logic and English literature in Owens College. He was an editor of the *Unitarian Herald* 1861–75; made a favorite rendering of Luther's 'Ein feste Burg'; wrote many original hymns, of which some appear in James Martineau's 'Hymns of Praise and Prayer' (1874); and published numerous tracts and sermons, besides 'Two Lectures on the Lancashire Dialect' (1844), appended to the 5th edition (1854) of the 'Mary Barton' of his wife, Elizabeth Cleghorn Gaskell (q.v.).

GASOLINE, a colorless, inflammable liquid, one of the lighter distillates of petroleum. In early use it was a general name for all the lighter oil ranking above kerosene, but as mineral oil came to be separated into a larger number of grades, of varying specific gravity, gasoline became the accepted name for distillate having a specific gravity between .629 and .667 (of 95° to 80° Baumé scale). The generally accepted European name for the same distillate is petrol. Gasoline has become of great commercial importance as the most convenient source of vapor for internal-combustion engines of the types used in automobiles, motorcycles, aeroplanes, etc. The continued increased demand forced up the price 70 per cent between July 1914 and July 1916.

Crude petroleum, under ordinary methods of distillation, yields but a small percentage of gasoline, and the increased demand stimulated effort to increase the supply, and improved processes are now yielding a much enlarged production of this valued distillate.

Gasoline, like all other products of crude petroleum, was for a long time disposed of as waste in the effort to make kerosene; it was there and had to come out. In the latter sixties it was exported to Europe in small quantities. Representing nearly the lightest portion of crude oil, gasoline is extracted by distillation, just as whisky is produced, and in much the same sort of apparatus. The stills or retorts may be of any shape and size; both are immaterial, and practice has differed. They may be cylinders placed horizontally and in banks, or cylindrical or conical, standing perpendicular and having curved domes. Rectification is effected by a copper coil, many feet in length inside the retort and passing through the crude petroleum, carrying steam at a high pressure, assisted by a gentle direct fire varying from 122° to 257° F. Each retort has an inlet pipe for the crude petroleum and an outlet pipe for the distillant. The outlet pipe passes over the side and down to a cooling coil or worm immersed in cold running water. This worm acts as a condenser that changes back to liquid form the vapors driven off the petroleum by the heat. A smaller pipe leads from the condenser to a receiver having glass sides through which the «still-man» can watch the flow of distilled oil. From the bottom of the receiver a number of pipes lead to different storage tanks, each pipe having a cut-off valve to regulate the flow of the varying gravities to their proper tanks, each cut-off being known as a «sweeping.» The first product from the retort is a gas formed by the mingling of the fumes of the petroleum with the small volume of air left in the reservoir; this is sometimes conveyed to the fire-box and used as fuel. When the first flow of the distillant reaches the receiver, the still-man tests it with a Baumé hydrometer for its specific gravity. Usually this first flow is found to be about .90 specific gravity. It is of a highly volatile nature, so nearly a gas that when exposed to air it rises in an invisible vapor and will quickly evaporate. It cannot be confined for any length of time in barrels, even if they have been successively coated inside with wax and repeatedly painted outside to make them air-tight. Even in the coldest weather it will pass through the wood. For these reasons this gravity is not put out commercially, but is used to bring up the gravity of a mass made up of lower gravities; that is to say, if .88 is being tanked the still-man lets all the .90, .89, .88 and enough of the .87 gravity oil flow into the receiver to make an average mixture of the density wanted. The oil is repeatedly tested with the hydrometer until the right gravity has been produced in the receiver, when it is let off to the proper storage tank. If .82 is the next grade wanted, all the gravities from .86 down to perhaps .78 are commingled in the receiver until a uniform fluid of the required gravity is obtained to let off into its tank. This process is called «fractioning,» and is continued through the next distillant, down to about .42 specific gravity.

When the demand for more gasoline began to press upon the petroleum industry, it was at first met by the recovery of more «casing-head gas.» Natural gas and petroleum come from the same wells, usually on the first flow the gas being in the excess, for it is simply the vapor of petroleum. Much natural gas is lost from new wells, but it is possible to conserve a large part of the lighter product at the casing-head or mouth of the well, and much of the light oil, in a condition closely approaching gas, is now retained in the casing-head and drawn off for distillation into gasoline.

About 1913 the «cracking» process of producing gasoline began to come into use, being first exploited as a secret process; but its principle has gradually become known and it is now generally practised by oil refiners. Crude oil, which has yielded its product of gasoline and other of the lighter distillates by the ordinary methods, is confined in a vessel and subjected to both heat and pressure, which breaks up the hydrocarbons or «cracks» the oil. One authority gives 932° F. as the proper temperature and 50 to 75 pounds the proper pressure for cracking oil to secure gasoline. In a preferred form of cracking apparatus the top and walls of the cylinder containing the oil are lined with steel balls, placed in layers. The oil is vaporized in passing out through the mass of hot balls, and released by a valve into an upper gasoline tank. Another type of cracker heats and compresses the oil in a coil or tube, which is so arranged that the production is continuous. It is a peculiarity of the cracking process that it may be repeated many times, and more gasoline is formed every time. Even the heavy oil paraffine can be cracked into crude oil, and the crude oil cracked into gasoline. The cost of cracking is not prohibitive, and it appears to have settled the problem of gasoline supply.

GASOLINE ENGINE. See Internal Combustion Engine.

GASOMETER, or GAS HOLDER, an inverted cylindrical vessel of sheet iron, placed in a tank of cast iron, stone or brick containing water. A pipe ascends from the bottom of the tank through the water, to admit the gas to the space between the surface of the water and the crown of the gas holder. Sometimes a second pipe descends through the water and the bottom of the tank, for the issue of the gas to the main pipe. Frequently only one pipe is used for the inlet and outlet alternately. The water is for the purpose of retaining the gas within the vessel. The pressure of the gas raises the gas holder; and the weight of the gas holder, or such part of it as is not taken off by balance weights, impels the gas through the pipes. When balance weights are necessary, they are attached to the edge of the crown of the gas holder by long chains, which pass over pulleys on the top of columns which serve also to guide the motion of the vessel in rising and falling. Gas holders are constructed of various sizes, some exceeding 200 feet in diameter and having nearly 6,000,000 cubic feet capacity.

GASOMETRIC ANALYSIS. In chemistry, the art of separating and of estimating, quantitatively, the several constituents of a gaseous mixture. The methods employed may be divided into three general classes: (1) Those based on diffusion; (2) those based upon the absorption of certain constituents by substances over or through which the mixed gases are passed; and (3) those in which the given mixture is oxidized and its original composition inferred from an examination of the products of the oxidation. In the application of diffusion methods, the mixture is caused to pass through a porous septum of graphite, gypsum or baked clay. The lighter constituents pass through faster than the heavier ones, so that a partial separation is effected. By causing the mixture to pass through a succession of such porous partitions, the concentration effects may be correspondingly increased. This method has been employed in many chemical researches, especially for effecting the concentration of gaseous substances that are present in a mixture in very small quantity. Its value as an experimental method was well demonstrated in connection with the study of the rare gases of the atmosphere, in effecting the separation of helium from argon. In general, the rates of diffusion of two gases are proportional to the square roots of their densities; and the density of argon being 10 times that of helium, it follows that helium will diffuse through a porous septum about 3.2 times as fast as argon.

In the analysis of gases by the absorption of certain of their constituents by means of chemical substances, use is made of the following facts (among others): Water absorbs HCl, HBr, and HI, very readily; solid caustic potash, when moist, absorbs all acid gases, such as CO_2, SO_2, H_2S, HCl, etc.; dilute sulphuric acid absorbs all alkaline gases, such as ammonia; concentrated sulphuric acid also absorbs water, alcohol, ether, methyl oxide, and (more slowly) propylene and its homologues; alkaline solutions of pyrogallic acid absorb oxygen very readily; cuprous chloride in solution in hydrochloric acid absorbs oxygen and carbon monoxide; and solutions of CrO_3 and of $KMnO_4$ absorb H_2S and SO_2. In the study of special problems, certain unusual absorbents also suggest themselves. Thus in the isolation of the rare gases of the atmosphere, great use was made of the fact that red-hot metallic magnesium absorbs nitrogen gas, while it is without effect upon argon, helium, and the other gases of that group.

The combustion methods are particularly applicable to those cases in which the mixture to be analyzed is capable of being burned so that the final products are water, carbon dioxide, and free nitrogen, together with excess of such gas as may have been added in order to effect the combustion. The combustion is effected in an instrument called a «eudiometer,» which commonly consists of a graduated glass tube that is closed at the upper end, and which is provided with a pair of platinum electrodes fused through the glass near the closed end. A sample of the gas to be analyzed is introduced into the tube (the lower end of which dips into a mercury bath), and its volume is determined by reference to the graduation marks; readings being simultaneously taken of the thermometer and barometer, so that the observed volume of the gas can be reduced, in the subsequent calculations, to standard conditions of temperature and pressure. A known quantity of such gas as may be required to effect the combustion is next added; pure oxygen being used if the gas under examination is rich in carbon and hydrogen, and pure hydrogen being used if it is highly oxygenated or chlorinated. It is usual, also, to add a known quantity of «fulminating gas,» which is prepared by the electrolysis of water and consists of pure oxygen and hydrogen in the proportion in which they combine to form water. The mixture is then exploded by passing an electric spark between the electrodes that are sealed into the eudiometer near its closed end, and after the heat developed by the explosive combustion has been lost by radiation, the volume of the mixture is again determined. The several constituents that remain in the eudiometer tube are then removed, one by one, by the temporary introduction, into the tube, of suitable absorbent substances. The volume of the gaseous contents of the eudiometer tube are observed after each partial absorption, and from the data so obtained the quantities of carbon, oxygen, hydrogen and nitrogen that were present in the original sample may be calculated. Consult Hempel, 'Methods of Gas Analysis' (trans. New York 1912); Sutton, 'A Systematic Handbook of Volumetric Analysis' (10th ed., London 1911). See also, in this encyclopædia, CHEMICAL ANALYSIS; SPECTROSCOPE.

GASPARIN, găs'pă'răṅ, **Agénor Etienne,** COMTE DE, French author: b. Orange, France, 12 July 1810; d. near Geneva, Switzerland, 4 May 1871. Elected to the Chamber in 1846, he attracted attention by his advocacy of religious liberty, prison reform, abolition of slavery and social purity. At the outbreak of the American Civil War he published two books maintaining the justice of the Federal cause entitled, 'The Uprising of a Great People' (1861), and 'America Before Europe' (1862). Other important works were 'Slavery' (1838); 'Christianity and Paganism' (1850); 'Liberal Christianity' (1869); 'Innocent III,' published posthumously.

GASPARIN, Valérie Boissier, COMTESSE DE, French author: wife of A. E. de Gasparin (q.v.): b. Geneva, Switzerland, 13 Sept. 1813; d. near Geneva, 1894. Two of her works obtained the Montyon prize at the Academie Française: 'Marriage from the Christian Point of View,' and 'There are Poor in Paris and Elsewhere.' Among her other publications are 'Journey in the South by an Ignoramus'; 'Let's Go Make a Fortune in Paris'; 'A Book for Wives'; 'Read and Judge' (strictures on the Salvation Army), and 'The Near and the Heavenly Horizons.' Several of her books were translated into English, the last named being read very widely in America in its English form.

GASPÉ, găs'pā', **Philip Aubert de,** Canadian author: b. Quebec, 30 Oct. 1786; d. there, 29 Jan. 1871. A lawyer, afterward sheriff, he became involved in debt for which he was imprisoned four years; and when released, secluded himself on his estate of Saint Jean Port-Joli. His 'Old-Time Canadians' (1863), and his 'Memoirs' (1866), treat of Canadian traditions and folklore, and were written in French. The former was perhaps the most popular book ever published in the province of Quebec. English translations have been made by Mrs. Pennie and G. C. D. Roberts.

GASPÉ, Canada, a district in the province of Quebec, consisting of the counties of Gaspé and Bonaventure, and forming the northern part of the peninsula that lies between the Bay of Chaleur and the Gulf of Saint Lawrence. Area, 8,015 square miles. Pop. (1911) 63,111. The name is sometimes extended to the whole peninsula. Cape Gaspé is a bold headland of the Schikshock or Notre Dame Mountains, terminating the peninsula and forming the north shore of Gaspé Bay. The inhabitants are chiefly engaged in important fisheries, which, with the export of lumber, form the staple industries. Gaspé, a village and port of entry in Gaspé Bay where Cartier landed in 1534, set up a cross and assumed formal possession in the name of the king of France, is the capital and commercial centre of the district. Pop. 606.

GASPEE, The, British revenue vessel, burned 1772. She was an armed schooner of eight guns, stationed at the entrance of Narragansett Bay to prevent that evasion of the British navigation laws which had largely built up the prosperity of the Atlantic Coast and was almost the entire subsistence of Rhode Island. Its authorities connived at the traffic, and at a regular price furnished false flags, which for years passed muster, but Lieutenant Dudingston of the *Gaspee* adopted the method of searching thoroughly every trading vessel which entered or left the bay, without regard to her flag or papers, and sending the contraband goods to Boston for adjudication. This meant ruin to Rhode Island; the executive wrote demanding Dudingston's authority, and the chief justice sent a sheriff on board; both held that his proceedings were illegal, as he should have a commission from the governor and be sworn in. They were referred to the admiral, and then to the British Secretary of State. On 9 June 1772, the regular packet left Newport for Providence without notifying Dudingston, who gave chase but ran the *Gaspee* aground at Namquit Point, seven miles below Providence, at low tide. That night the leading men of that city, with a company of assistants, set out in eight large boats, boarded and captured the vessel, badly wounding the commander, set the crew on shore and burnt the schooner. The Rhode Island authorities opened an investigation with great zeal, and offered rewards for the apprehension of the guilty persons, but could discover none. The home government was greatly incensed, and appointed colonial commissioners, who sat at Newport 4–22 Jan. 1773, to make inquiry, and ordered Governor Wanton to arrest the offenders and send them to England for trial. The governor and the chief justice applied to the assembly for instructions, which body referred it to the discretion of the chief justice, who refused to allow any arrests for transportation to be made.

GASQUET, găs'kā', **Francis Aidan,** CARDINAL, English Catholic divine and historian: b. London, 5 Oct. 1846. He was educated at Downside, became a novice of the Benedictines at Belmont in 1865 and was ordained to the priesthood in 1874. He was prior of Downside from 1878 to 1885. During his term of office the school was modernized and the abbey church begun and carried on toward completion. In 1886 he began systematic historical research work. He was a member of Leo XIII's Commission on Anglican Orders in 1896; was the recipient of a brief from that pontiff dated 17 March 1897 and was appointed by Pius X a consultor of the pontifical Commission for the Reunion of Dissident Churches. He was abbot-president of the English Benedictine Congregation and abbot-titular of Saint Alban's, Reading, in 1900–14. During his term of office, Downside, Ampleforth and Donai-at-Woolhampton were raised to the rank of abbeys; a house of studies was opened near the British Museum, and another at Cambridge. In 1907 he was appointed president of the Commission formed to examine the text of the Latin Vulgate Bible and to collect material for amending it. At the last consistory held by Pius X, in May 1914, he was created a cardinal priest by the title of Saint George in Velabro (Cardinal Newman's titular church). This church he resigned in 1916 for that of Santa Maria in the Campitelli. As a writer Cardinal Gasquet has won a generally conceded supremacy as the authority on Pre-Reformation monasticism in English. Among the works which have gained him his pre-eminence as a historian are 'Henry VIII and the English Monasteries' (1888–89); 'Edward VI and the Book of Common Prayer' (1890); 'The Great Pestilence' (1893); 'The Last Abbot of Glastonbury' (1895); 'A Sketch of Monastic Constitutional History' (1896); 'The Old English Bible and Other Essays' (1897); 'The Eve of the Reformation' (1900); 'A Short History of the Catholic Church in England' (1903); 'Collectanea Anglo-Premonstratensia' (Vol. I, 1904, Vol. II, 1906); 'English Monastic Life' (1903); 'Vita Antiquissima Beati Gregorii Magni' (1903); 'Henry III and the Church' (1905); 'Lord Acton and his Circle' (1906); 'Parish Life in Mediæval England' (1906); 'The Greater Abbeys of England' (1908); 'The Bosworth Psalter' (1908). He is also known as the editor of Montalembert's 'Monks of the West'; 'Lord Acton's Letters,' and other works.

GASSENDI, gă'săn'dē' (properly **GASSEND), Pierre,** French philosopher and mathematician: b. Champtercier, near Digne, Provence, 22 Jan. 1592; d. Paris, 24 Oct. 1655. At 19 he was appointed to fill the chair of philosophy at Aix, and although the authority of Aristotle was still warmly maintained, he ventured publicly to expose the defects of his system. His lectures on this subject, 'Exercitationes Paradoxicæ adversus Aristotelem' (1624), gave great offense to the votaries of the Aristotelian philosophy, but obtained him no small reputation with others, through whose interest, after taking orders, he was made doctor of divinity. A second book of 'Exercitationes' excited so much enmity that he ceased all direct attacks on Aristotle, although he still maintained his preference for the doctrines of Epicurus, which he defended with great learning and ability. He strenuously maintained the atomic theory, in opposition to the views of the Cartesians, and, in particular, asserted the doctrine of a vacuum. On the subject of morals he explained the doctrines of Epicurus in a sense the most favorable to morality. He was appointed lecturer on mathematics in the Collége-Royal at Paris in 1645. He is ranked by Barrow among the most eminent mathematicians of the age, and mentioned with Galileo, Gilbert, and Descartes. Gassendi was the first person who observed the transit of Mercury over the sun. His chief works are 'De Vita Moribus et Doctrina Epicuri' (1647); 'Institutio Astronomica,' 'Syntagma Philosophiæ Epicuri' (1649); 'Tychonis Brahæi Copernici, Peurbachii et Regiomontani Vitæ' (1654).

GASTER, Moses, Jewish theologian and Orientalist: b. Bucharest, 16 Sept. 1856. Graduating from the Breslau University (1878), he returned to his native city, where he published a history of Rumanian popular literature (1883) and became lecturer in Rumanian language and literature at Bucharest University (1881–85). In 1885, having been expelled by the government, he went to England, where he was appointed Ilchester lecturer in Slavonic literature at Oxford, his lectures being published in 1886 under the title 'Greco-Slavonic Literature.' He refused the government's invitation to return home, although the decree of expulsion was canceled. His report on British education (1895) at Rumania's request was accepted as a basis for educational reform in that country. In 1887 he was appointed *Haham* or rabbinical head of the Spanish and Portuguese Synagogue of London and from 1891–96 principal of the Judith Montefiore College, Ramsgate. A writer of many monographs in the transactions of Oriental societies, he published 'Jewish Folk-Lore in the Middle Ages' (London 1887); 'The Sword of Moses' (1896); 'The Character of Jerahmeel' (1899); 'History of the Ancient Synagogue of the Spanish and Portuguese Jews' (1901); and contributed numerous articles to periodicals in Oriental lore. He is prominently identified with the English Zionists.

GASTINEAU, gās'tē-nō', **Benjamin,** French author: b. Montreuil-Bellay, 1823; d. 1904. He learned the trade of printer and in 1851 wrote a series of articles for *L'Ami du Peuple*. The publication of these led to his arrest and subsequent exile to Algeria. Three years later he returned to France and in 1856–58 edited the *Guetteur de Saint-Quentin*. His management of this journal again brought him in conflict with the authorities and he was again sent into exile. He returned in 1871 and by the Communists was put in charge of the Mazarin Library. He was again exiled in 1872 but returned within a short time under the terms of a general amnesty. His published works include 'La lutte du catholicisme et de la philosophie' (1844); 'La bonheur sur terre' (1844); 'La guerre des Jésuites' (1845); 'L'Orpheline de Waterloo' (1847); 'Le régime de Satan, ou les riches et les pauvres' (1848); 'Les femmes et les mœurs de l'Algérie' (1852); 'Histoire de la folie humaine' (1862); 'Les femmes des Césars' (1863); 'Les génies de la liberte' (1865); 'Les socialistes' (1865); 'Les drames du mariage' (1865); 'Les victimes d'Isabelle II' (1868); 'L'Impératrice du Bas-Empire' (1870); 'Le centenaire de Voltaire' (1878); 'Les femmes et les prêtres' (1888); 'Les crimes des prêtres de l'église' (1891).

GASTON, William, American jurist: b. Newbern, N. C., 19 Sept. 1778; d. Raleigh, N. C., 23 Jan. 1844. He was graduated at Princeton 1796; was admitted to the bar 1798; elected to the State senate 1799; and congressman 1813–17, voting with the Federalists and opposing the "Loan Bill." Returning to the practice of the law he obtained great reputation as an orator, and was frequently a member of the State legislature. He drew up the act creating the Supreme Court of North Carolina and served as judge of that court 1834–44. During his later years he was a Whig, opposing nullification.

GASTONIA, N. C., city and county-seat of Gaston County, 24 miles west of Charlotte, on the Carolina and Northwestern, the Piedmont and Northern and the Southern railroads. It contains several industrial establishments, including cotton and cottonseed-oil mills, wood fibre works, cement and broom factories, and manufactories of cotton-mill machinery. The city government is vested in a mayor and council and owns the electro-lighting plant and the water supply. Pop. 5,800.

GASTORNIS, a genus of fossil birds of the epyornis family, whose remains, indicating several species, have been found in the Eocene rocks of both England and France. They were birds of the size of an ostrich, with long legs, weak wings and little if any power of flight.

GASTRÆA, găs-trē'ạ, a hypothetical primitive animal consisting simply of a sac or stomach, with an ectodermal and endodermal layer of cells. This simple organism, to which the embryonic gastrula-stage (see EMBRYOLOGY) is the nearest modern approach, and was regarded by Hæckel as recapitulative of the primitive gastræa, Hæckel assumes to have been the first animal generated on the earth, and the germ from which the whole animal kingdom with its infinite diversities was gradually evolved. His hypothesis, called the Gastræa theory, asserted that there must have been many species, families, etc., of these primitive organisms, whence all the *Metazoa* have been evolved. These generalizations were announced by Hæckel in 'Die Gastræa-theorie, die Phylogenetische Classification des Thierreichs und die Homologie der Keimblätter,' published at Jena in 1874, and have since been extensively considered in all works on embryology.

GASTRALGIA. See INDIGESTION.

GASTRECTOMY, the removal of a part or the whole of the stomach-wall. It is performed for the cure or relief of deep ulcerations, cancerous growths or contractions of the wall that cause serious obstruction.

GASTRIC JUICE, the secretion of the stomach, is in man a clear almost colorless fluid of acid reaction, containing one-half of 1 per cent solids. The amount secreted varies with the demand, but approximates 1,600 cubic centimetres in 24 hours. In health secretion, takes place only under the stimulus of food. Hydrochloric acid, the chief constituent, is present in one or two parts per thousand. During the first stage of digestion it is all combined with the food, but later it is found free. The other important ingredients of this secretion are pepsin, a ferment that has the power of converting albuminous foods into forms that can be absorbed and assimilated; and rennin, a ferment that causes coagulation of milk by converting the casein, one of the milk proteids. Inorganic salts, the alkaline chlorides and phosphates, and phosphates of calcium, magnesium, and iron constitute most of the solids.

GASTRITIS, găs-trī'tĭs, a general term that includes all strictly inflammatory diseases of the stomach. Acute gastritis or acute gastric catarrh is an acute inflammation of the lining mucous membrane. The membrane becomes swollen, is covered by a coating of tenacious mucus and tends to bleed at minute points. Errors in diet, either by over-indulgence or the ingestion of improper food, is the most frequent cause of the malady. Certain chemicals and drugs, very hot food or liquid, foreign bodies and unripe fruits may cause the irritation. The symptoms depend on the severity of the inflammation, the milder forms being spoken of as subacute. Frequently premonitory symptoms, such as a feeling of fullness or tenderness, or the eructation of gases, may be noticed, and may be soon followed, in the more severe cases, by nausea, vomiting and a rise of temperature, accompanied by painful thirst. If the retching or vomiting of mucus continues, there is apt to be great weakness and prostration. The duration of the disease under proper treatment is seldom over three or four days. The stomach should be given absolute rest for 24 hours, or even longer if nausea or retching continue. The intense thirst may be relieved by small pieces of ice, but not even the drinking of water is permitted. Rest in bed may be indicated in the more severe cases and, if so, hot poultices applied to the stomach region relieve some of the distressing symptoms. Drugs are of little value except to quiet excessive vomiting. Toxic gastritis is that form caused by the ingestion of corrosive and irritating drugs and chemicals. It is a severe form of acute catarrh, with the added effect of the particular poison taken. Strong acids and corrosives cause destruction of the deeper tissues, with ulceration and even perforation of the wall. The treatment depends upon the poison taken, but dilution by the imbibing of demulcent drinks is usually of value if taken sufficiently early. Chronic gastritis or chronic gastric catarrh is a chronic inflammatory change in the mucous membrane of the stomach. It is a most wide-spread malady, affecting all classes and ages. Not uncommonly successive attacks of acute gastritis, even in early life, start those progressive changes that sooner or later make themselves known as chronic catarrh. The most common cause is the repetition of irritants taken into the stomach in food, both as to quantity and quality, and in drink irritating from high temperature or presence of alcohol. Other causes may operate, such as venous congestion from disease of the heart, liver and spleen, changes in the blood-elements and the constant poisoning of infectious diseases. A most important cause for chronic gastritis is a continuous mental irritability, which accompanies intense anxiety, impatience, bad temper and inability to push one's work ahead with ease and *sang froid*. Liberal doses of good humor and increase of human sympathy will cure this.

For an understanding of the symptoms of this affection it must be appreciated that three mechanisms make up gastric digestion — the nervous, the muscular, and the secretory. Deviation from the normal in any one of these is almost certain to act on the others, and when, in addition to these mechanisms, the close relation of the stomach and other digestive organs is considered, a marvelous complex is apparent. The symptoms of a chronic catarrh may be unnoticed, may be merely evidenced by changes due to poor gastric digestion, or interwoven with resulting derangement of all the digestive apparatus. In the early stages the mucous membrane is swelled, the gastric juice still has its normal ingredients and in addition the membrane secrets a mucus owing to degeneration of the cells. From this stage to a complete absence of acid, and then of ferments the change is gradual, the final stage being known as atrophic gastritis. No symptom or group of symptoms is characteristic of the disease, the diagnosis being made with accuracy only by examination of the gastric contents. At one time or another one or more of the following symptoms are noticed: Absence of appetite, bad taste in the mouth, coated tongue, nausea and, occasionally, vomiting, eructation of gases and some liquid, heartburn, and a feeling of fullness or bloating after meals. The presence of inflammation, and the stage, are determined by chemical and microscopical analysis of the contents of the stomach after a test-meal has been eaten. In all except the atrophic stage there is always more or less mucus found mixed with the food. This is the distinguishing feature.

Of itself the disease is not fatal, but severe disorders of nutrition may result that render the sufferer more liable to other diseases.

The treatment consists in correction of the causes as much as possible, particularly in a dietetic regimen free of irritation and of ready digestibility. Lavage or washing of the stomach is of supreme importance where it can be borne. Drugs are of little use except for the relief of distressing symptoms. Where great diminution or absence of acid is found, it may be supplied, but the large amount necessary usually makes the procedure impracticable. Electricity, massage and hydrotherapy may be beneficial.

GASTROENTERITIS. See CHOLERA; ENTERITIS.

GASTROMANCY. See SUPERSTITION.

GASTROPODA, the largest and most typical and familiar of the four classes of mollusks (phylum *Mollusca*). The name refers to the most prominent tribal characteristics, namely, that the inferior surface of the body forms a flattened sole or disc called «foot,» by the contractions of which the animal advances. In all these animals the primitive symmetry of the body is obscured by the unequal development of parts, whence results the spiral disposition of the majority. The simplest gasteropods, however, such as the chiton, are symmetrical, not lop-sided like the higher forms. They have the mouth at one end of the long axis of the body, the anus at the other; the gills, kidneys, genital ducts, and circulatory organs are paired; there are two pairs (pedal and visceral) of nerve cords running parallel to one another along the body, and the ganglia are slightly developed. Of all mollusks these simplest gasteropods are probably nearest the hypothetical worm-like ancestor. When a shell is present it consists of only one piece, whence the name «univalve,» formerly applied to the class; or if of more than one piece the separate portions are placed one behind the other in the axis of the body (*Amphineura*, chitons). The gasteropods agree with the cephalopods in possessing a distinct head, containing a feeding instrument or «tongue» in the form of a lingual ribbon, but are separated from that class by the mode of formation of the shell, and by the absence of arms around the head. The lingual strap or odontophore consists of a central portion (*rachis*) and lateral pieces (*pleuræ*). On all three of these, on the central, or only on the lateral regions are placed silicious denticles, whose number, form, and arrangement have been made the basis of classification of genera.

Mode of Life.— Though the number of terrestrial gasteropods, breathing the air directly by means of a pulmonary chamber, is very large — over 6,000 living species — those living in water are greatly in the majority, including over 10,000 forms, mostly marine. Of these, some 9,000 or so belong to the prosobranchs or *Streptoneura*, a relatively small minority being opisthobranchs and nudibranchs. The heteropods and some opisthobranchs enjoy a free-swimming pelagic life, but most marine forms frequent the coasts either on the shores or along the bottom. Deep-sea gasteropods are comparatively few. The locomotion effected by the contractions of the muscular «foot» is in almost all cases very leisurely, and the average tendency is toward sluggishness. As to diet, the greatest variety obtains; most prosobranchs with a respiratory siphon and a corresponding notch in the shell are carnivorous, and so are the active heteropods; most of the rest are vegetarian in diet. Numerous genera, both marine and terrestrial, are very indiscriminate in their feeding; others, are as markedly specialists, keeping almost exclusively to some one vegetable or animal diet. Some marine snails partial to echinoderms have got over the digestive difficulty presented by the calcareous character of the skins of their victims by a secretion of free sulphuric acid from the mouth. This acid changes the carbonate of lime into sulphate, which is brittle and readily pulverized by the rasping tongue. A few are parasitic — for example, eulima, stylifer, and the very degenerate *Entoconcha mirabilis*, all occurring in or on holothurians.

Life-history.— The eggs of gasteropods are usually small, and are surrounded with albumen, the surface of which becomes firm, while in the common snail (*Helix*) and some others there is an egg-shell of lime. The eggs not unfrequently develop into embryos within the parent, but in most cases they are laid, either singly or in masses, and often with cocoons which take on various forms. Inside each of the numerous egg-cases are many embryos, but only a few reach maturity, the others serving as food material, an infantile cannibalism or struggle for existence not uncommon in the class. As to development it may be noted that the ovum divides more or less unequally, according to the amount of yolk, that a gastrula-stage occurs as usual, and that this is succeeded in typical cases, first by a «trochophore» and afterward by a «veliger» larva (see MOLLUSCA).

General Interest.— As voracious animals, furnished with powerful rasping organs, many gasteropods play an important part in the struggle for existence among marine organisms. Oyster beds, for example, are infested by thousands of industrious «borers» of several kinds, that perforate the shells of oysters, clams, etc., fatally sucking out the life-blood of their occupants. Certain terrestrial forms, as slugs, are most destructive devastators of vegetable and flowering plants. From very early times, various gasteropods, such as whelks, have been utilized for human consumption and also as bait, while yet more frequently the shells, often so beautiful in form and color, have been used for the decoration of the person and the dwelling, for the basis of cameos, as domestic utensils, or even as weapons, and in many other ways. From the mucous glands of the roof of the gill-cavity in the genera *Purpura* and *Murex*, there exudes the famous secretion, at first colorless, but afterward becoming purple or violet, which furnished the ancient Tyrian dye. See SHELLS.

Geological History.—A few gasteropods occur in strata as far back as the Cambrian, from which remote period they have continued with a steady increase. Almost all the Palæozoic genera are now extinct, and during these ages the siphon-possessing forms seem to have been almost, if not altogether, unrepresented. A host of new gasteropods appeared in the Jurassic period, and many of the modern families have their origin in Cretaceous times. Numerous as the fossil forms are, the number of types wholly extinct is comparatively small; both as regards persistence of types and increase of numbers, the gasteropods are a peculiarly successful class.

Classification.— The grouping of forms within the class is as follows, according to the latest conclusions of naturalists, as summarized by Cooke in the third volume of the Cambridge 'Natural History' (1894):

Class GASTEROPODA; order *Amphineura;* sub-orders, *Polyplacophora, Aplacophora;* order, *Prosobranchiata;* sub-orders, *Diotocardia, Monotocardia;* order, *Opisthobranchiata;* sub-orders, *Tectibranchiata, Ascoglossa, Nudibranchiata, Pteropoda;* order, *Pulmonata;* sub-orders, *Basommatophora, Stylommatophora.*

(For the characters of the orders see *Classification* in the article ANATOMY). The subdivisions are based upon different anatomical categories in each order. Thus the first sub-order of *Amphineura* embraces all the ordinary chitons having a foot and plated shell, both of which are absent in the degraded *Aplacophora.* Among the *Prozobranchiata* (which embrace the ordinary marine shells) two auricles in the heart characterize the *Diotocardia,* a single auricle the *Monotocardia,* of which the strange pelagic *Heteropoda* are now regarded as only a subordinate group. The *Opisthobranchs* are classified according to gill-features; and the *Pulmonata,* according to relative position of the eyes.

See MOLLUSCA; SNAIL; WHELK, etc., and consult the works cited thereunder, especially Cooke, 'Shells' (New York 1896), in which will be found many instructive references to other authorities.

GASTROSTOMY, the operation of making a more or less permanent opening between the interior of the stomach and the overlying surface, the lining membrane of the stomach being joined to the skin entirely around the margin of the opening. This procedure is undertaken when for any reason the entrance of food into the stomach by natural passage is prevented.

GASTROTOMY, a simple incision of the wall of the stomach, usually undertaken for the exploration of the interior or for the removal of foreign bodies.

GASTRULA. See EMBRYOLOGY; GASTRÆA.

GASZYNSKI, gă-shin'skē, **Konstanty,** Polish poet: b. Malawies, 1809; d. 1866. He took part in the insurrection of 1830–31, and at its close removed to France, where he settled at Aix-en-Provence. He wrote in both verse and prose and his sonnets attracted general attention. In 1833 a collection of his stories was published in Paris. His works are 'Pieśni pielgrzyma' (1833); 'Poezye' (1856); 'Sielanka moldosci' (1855); 'Reszty pamietnika Macieja Rogowskiego' (1847); 'Kontuszowe pogadanki' (1851); 'Listy z podrozy po Wloszech' (1853); 'Pan Dezydery Boczko' (1846). In 1870–74 a collected edition of his works appeared.

GATA, gä'tą, **Cape de.** See CAPE DE GATA.

GATACRE, SIR **William Forbes,** English soldier: b. 1843; d. 6 March 1906. He joined the English army in 1862; was instructor of surveying in the Royal Military College in 1875–79; deputy-adjutant and quartermaster-general in the Hazara Expedition in 1888, and in the Burma, Tonhon, Expedition in 1889. He led the British forces in the Sudan in 1898, during the first advance against Atbara, and later commanded a British division in that region during the movement against Khartum and Omdurman. When the war in South Africa broke out he was ordered there and given an important command. He was repulsed at Stormberg with heavy loss. In April 1900 he was recalled to England.

GATAKER, Thomas, English Puritan divine: b. London 1574; d. 1654. He was educated at Saint John's College, Cambridge; became in succession preacher at Lincoln's Inn, rector of Rotherhithe and member of the Assembly of Divines at Westminster. He opposed the imposition of the covenant and was one of the 47 London clergymen who condemned the trial of Charles I. In 1652 appeared his 'Marcus Antoninus,' the Greek text with a Latin translation and commentary which Hallam pronounced "the earliest edition of any classical writer published in England with original annotations." He also wrote commentaries on Isaiah, Jeremiah, and Lamentations; 'Opera Critica' (1648; 1698); 'Of the Nature and Use of Lots' (1619; 1627); 'Cinnus, sive Adversaria Miscellanea' (1651). Consult Brook, 'Lives of the Puritans' (London 1813).

GATCHINA, gä'chē-nä. See GATSCHINA.

GATE CITY, The, a name given to Keokuk, Iowa (q.v.), and to Atlanta, Ga. (q.v.).

GATE OF TEARS, or **GATE OF MOURNING,** the Straits of Bab-el-Mandeb, Arabia; the term is an exact translation of the words Bab-el-Mandeb, which have reference to the many shipwrecks which anciently occurred thereabouts.

GATES, Caleb Frank, American Congregational clergyman: b. Chicago, Ill., 18 Oct. 1857. In 1877 he was graduated at Beloit College and in 1881 at the Chicago Theological Seminary, and was ordained to the Congregational ministry the same year. From 1881 to 1894 he labored as a missionary of the American Board of Commissioners for Foreign Missions at Mardin, Turkey, Asia Minor. In 1894–1902 he served as rector of Euphrates College, Harpoot, Turkey, and in 1903 was chosen president of Robert College, Constantinople. He published 'A Christian Business Man' (1893).

GATES, Eleanor (MRS. FREDERICK FERDINAND MOORE), American author: b. Shakopee, Minn., 26 Sept. 1875. She received her education at Stanford University and the University of California. While pursuing her studies she was on the staffs of the *Examiner, Call* and *Chronicle* of San Francisco, and the *Enquirer* of Oakland. In 1901 she married Richard Walton Tully, and in 1914 took as her second husband Frederick Ferdinand Moore. She is the author of 'The Biography of a Prairie Girl' (1902); 'The Plow-Woman' (1906); 'Good Night' (1907); 'Cupid, the Cow-Punch' (1907); 'The Justice of Gideon' (1910); 'Spinners' (1913); and the plays, 'The Poor Little Rich Girl' (1913), play and novel; 'We are Seven' (1913); 'Apron Strings' (1914); 'The Bad Angel' (1915).

GATES, Elmer, American psychologist and inventor: b. Dayton, Ohio, 1859. He was educated in common and normal schools, but mostly by private tutors, followed by special courses in several colleges. He has done much original work in electric meteorology and has made several electrical mining inventions. He is the author of a system of mind-building and experimental psychology, having four laboratories for experimental research in these fields. These have educational and not commercial ends in view. He has established an organization through which the new methods of scientific investigation will be made available and the new system of science-teaching practically applied, and is training associates therefor. He has devoted most of his inventions to the support of scientific research. He is professor of psychology at the Pennsylvania School of Industrial Art and is a member of the American Academy of Political and Social Science and many other learned societies. Among his works are 'Psychurgy or the Art of Using the Mind'; 'Art of Mind-Building.'

GATES, Frederick Taylor, American clergyman: b. Maine, Broome County, N. Y., 2 July 1853. In 1877 he was graduated at the University of Rochester and in 1880 at the Rochester Theological Seminary. He was ordained to the Baptist ministry in the latter year and for the ensuing eight years was pastor of the Central Church, Minneapolis. From 1888 to 1893 he was corresponding secretary of the American Baptist Education Society, and from 1893 to 1912 was employed as business and benevolent representative of John D. Rockefeller. He is chairman of the General Education Board and of the trustees of the Rockefeller Institute for Medical Research.

GATES, Horatio, American military officer: b. Maldon, Essex, England, 1728; d. New York, 10 April 1806. He joined the British army early in life; in 1755 was assigned to duty at Halifax, N. S., and later served with Braddock's expedition. In July 1775 Congress appointed him adjutant-general; in 1776 he was given a command in the Northern army and 2 Aug. 1777 assumed command of the Northern department. He defeated Burgoyne at Saratoga, 7 Oct. 1777, the British general surrounding his army on the 17th. (See SARATOGA, BATTLE OF). In November of the same year he was appointed president of the new Board of War and Ordnance; and in 1778, while holding that post, sought with the aid of his friends in Congress to supersede Washington as commander-in-chief. This action soon brought him into discredit, and he resigned from active service. In June 1780 he again entered the army, becoming commander of the troops in North Carolina. On 16 August of that year his army was defeated near Camden, S. C. He was soon afterward suspended from duty, but reinstated in his command in 1782, after the capture of Cornwallis.

GATES, Lewis Edwards, American educator and critic: b. Warsaw, N. Y., 23 March 1860. He is a brother of M. E. Gates (q.v.). He was graduated at Harvard 1884, instructor in forensics there 1884–87, instructor in English 1890–96, then becoming assistant professor of English. He is a frequent contributor of critical articles to the magazines and became well known by his critical essays on Matthew Arnold, Francis Jeffrey and John Henry Newman, which were published in volumes of selections from their writings. He has published 'Selections from Jeffrey' (1894); 'Selections from Newman' (1895); 'Selections from Matthew Arnold' (1898); 'Three Studies in Literature' (1899); 'Studies and Appreciations' (1900).

GATES, Merrill Edwards, American educator: b. Warsaw, N. Y., 6 April 1848. He was graduated at the University of Rochester 1870, was principal of the Albany Academy 1870–82, president of Rutgers College 1882–90, and president of Amherst College 1890–99. He has been very active in promoting civil service measures, and ballot reform. He was made chairman of the United States Board of Indian Commissioners 1884, and was president of the American Missionary Association 1893–98. For several years he was president of the Lake Mohonk Indian Conference. He received the degree of LL.D. from a number of universities. He has published 'Athens and the Greeks of To-day'; 'Sidney Lanier, Poet and Artist'; 'The Debt the School Owes the State'; 'Land and Law as Agents in Educating the Indians' (1885); 'International Arbitration' (1897); 'The Highest Use of Wealth' (1901). He has written and lectured much upon religious, social and educational themes.

GATES, Seth Merrill, American public official: b. Herkimer County, N. Y., 1800; d. 1877. In 1827 he entered on the practice of law at Le Roy, N. Y. On his election to the State legislature in 1832 he procured a charter for the first railroad in western New York, which subsequently became part of the New York Central system. In 1838 he became editor and proprietor of the Le Roy *Gazette*. He was a member of Congress from 1839 to 1843 and author of the famous protest by the Whigs in that body against the annexation of Texas in 1843. His opposition to slavery provoked a Georgia planter to offer $500 for him "dead or alive."

GATES, SIR Thomas, English colonial governor of Virginia: d. after 1621. He sailed from England in May 1609, in charge of a colony of 500 emigrants to the New World, but his vessel, the *Sea Venture*, was stranded on the rocks of Bermuda. Here the passengers built two new ships and finally reached Virginia in May 1610. Gates went to England in the meantime and returned in 1611 with 300 more emigrants. He was made governor the same year and held that office till 1614, when he returned to England.

GATESHEAD, England, a parliamentary, municipal, county borough and seaport of Durham, on the south side of the Tyne, opposite Newcastle. The church of Saint Mary is a handsome cruciform structure assigned to the 12th century, but it has been almost entirely rebuilt, the earlier edifice having been burned in 1854. Trinity Chapel is believed to occupy the site of an ancient monastery. Among the public buildings are the town hall, public library and hospitals. There is also a public park of 52 acres. The manufacture of locomotives, anchors, chain cables, etc., is extensively carried on. The Northeastern Railway has repair shops here and there are large chemical and glass works. Excellent grindstone is quarried and coal is mined. Daniel Defoe lived here and his dwelling is still pointed out. Consult Welford, 'History of Newcastle and Gateshead' (Newcastle-on-Tyne 1885).

GATESVILLE, Tex., city and county-seat of Coryell County, on the Saint Louis Southwestern Railroad, 80 miles north of Austin. It is situated in the fertile valley of the Leon River and has considerable agricultural, stock-raising and produce-shipping interests. There are cotton gins and compress, oil works and flour and planing mills. The State Juvenile Training School is situated here. Pop. 1,929.

GATEWAY, the opening in a castle or other wall which may be closed by a door or gate hung at its edge. The gateway being a most important point in all fortified places, is usually protected by various devices. It is flanked by towers with loopholes, from which assailants may be attacked, and is frequently overhung by a machicolated battlement, from which missiles of every description may be poured upon the besiegers. In the Middle Ages gates were also fortified with one portcullis or more, and had frequently an outer work or barbican in front of the gate defended with drawbridges. City gates and gates of large castles have in all ages been the subjects of great care in construction; and when from some cause, such as the cessation from constant fighting, or a change in the mode of warfare, gateways have lost their importance in a military point of view they have maintained their position as important architectural works, and although no longer fortified have become ornamental. In very ancient times we read of the «gate» as the most prominent part of a city, where proclamations were made, and where kings administered justice. The Greek and Roman gates were frequently of great magnificence. The propylæa at Athens is a beautiful example, and the triumphal arches of the Romans are the ornamental offspring of their city gates. At Autun in France two Roman gateways, and at Trèves in Germany one, still exist, and formed the models on which early mediæval gateways were designed. Most of the English towns have lost their walls and city gates; but a few, such as York and Chester, still retain them, and give us an idea of the buildings which formerly existed, but which now remain only in the name of the streets where they once stood. English castles retain more of their ancient gateways, and from these we may imagine the frowning aspect these large buildings presented during the Middle Ages. Abbeys, colleges and every class of buildings were shut in and defended by similar barriers; many of these still exist at Cambridge and Oxford.

GATH. See TOWNSEND, GEORGE ALFRED.

GATH (Heb. «wine-press»), one of the five cities of the Philistines which were presided over by so many princes or lords from the time of Joshua to a comparatively late period. It was situated on the borders of Judah, and was in consequence a place of much importance in the wars of the Jews and the Philistines. It is stated in Joshua that Gath was one of the cities in which, at the time of the conquest, there still remained some of the ancient Anakims or giants, and they appear to have perpetuated the race here till much later times, for it was from Gath that the renowned Goliath issued. The exact site of the ancient city cannot be determined with any degree of certainty, but some identify it with the eminence Tell-es-Sâfieh, about midway between Ekron and Ashdod.

GATHAS, gä'thäz. See AVESTA; LALITA-VISTARA; ZOROASTER.

GATINEAU, gä'tē'nō', a river of Canada, in the province of Quebec, rising in a chain of lakes in the county of Waight (48° N. latitude) from which it flows south, and falls into the Ottawa opposite the city of Ottawa. The scenery on its course is of the wildest and most romantic description. Great quantities of lumber are floated down the river. Its total length is 240 miles.

GATLING, Richard Jordan, American inventor: b. Hertford County, N. C., 12 Sept. 1818; d. New York, 1903. While a boy he assisted his father in perfecting a machine for sowing cotton seed, and another for thinning out cotton plants. Subsequently he invented a machine for sowing rice. Removing to Saint Louis in 1844, he adapted this invention to sowing wheat in drills. For several winters he attended medical lectures in Cincinnati, and in 1849 removed to Indianapolis, where he engaged in railroad enterprises and real estate speculations. In 1850 he invented a double-acting hemp brake, and in 1857 a steam plow, which, however, he did not bring to any practical result. In 1861 he conceived the idea of the revolving battery gun which bears his name. Of these he constructed six at Cincinnati, which were destroyed by the burning of his factory. Afterward he had 12 manufactured elsewhere, which were used by General Butler on the James River. In 1865 he improved his invention, and in the year following, after satisfactory trial, it was adopted into the United States service. It has also been adopted by several European governments. At the time of his death he was perfecting a few business formalities prior to placing his new motor plow on the market. Although best known as the inventor of a terrible death-dealing weapon, he was the gentlest and kindliest of men. The sight of returning wounded soldiers early in the Civil War led him to consider how war's horrors might be alleviated. By making war more terrible, it seemed to him nations would be less willing to resort to arms, and he accordingly devoted himself to the study of ordnance and ballistics, with this end in view.

GATLING GUN. See GUNS.

GATSCHINA, or **GATCHINA,** Russia, town in the government of Petrograd, 30 miles by rail west of Petrograd. A former suburban residence of the Russian tsars, the imperial palace of Italian design, dating from 1770, is the chief building, and other notable features are the model military barracks, military orphanage, horticultural school and porcelain factory. On 29 Oct. 1799, the treaty of alliance between Russia and Sweeden was signed at Gatschina. Pop. 15,000.

GATTI, găt'tē, **Bernardino** («Il Solaro»), Italian painter: b. Cremona, about 1493; d. 1575. He was in all probability the pupil of Correggio, but he certainly imitated the latter to such a degree that his work is with the greatest difficulty identified from that of the master. He painted the cupola of the Steccata at Parma and completed the tribune of Pordenone in Santa Maria di Campagna, Piacenza. Many of his works are in the cathedral of Parma and in Saint Peter's, Cremona. Pavia Cathedral has his 'Mater Dolorosa.'

GATTI-CASAZZA, găt'tē-kă-zăt'să, **Guilio,** Italian operatic manager: b. Udine, Italy, 3 Feb. 1869. He received his education at Ferrara and Bologna and in 1890 was graduated naval engineer at the Polytechnic College of Genoa. His father had been director of the municipal theatre at Ferrara and in 1892 was called to another position at Rome. Giulio thereupon abandoned his proposed career of engineer and took charge of the theatre at Ferrara, where he remained until 1898. From 1898 to 1908 he was director of the Teatro Allà Scala of Milan, and made that house the foremost operatic centre of Italy. His conspicuous success there attracted such general attention that in 1908 he was induced to become director of the Metropolitan Opera House, New York. Here he again made a wonderful administrative success and this great institution has under him reached the pinnacle of success both artistically and financially. He has always encouraged home talent and every season sees the production of at least one new opera by an American composer. The able hand of the director is discernible in every department. In 1910 he took his company to Paris and the French capital was amazed at the exceedingly capable artists and management from overseas. It is safe to say that Mr. Gatti-Casazza has made the famous New York opera house the premier of the world in its field. On 4 April 1910 he married Frances Alda, a member of his company. He is director of the New York Institute of Musical Art.

GATUN. See Panama Canal.

GAUBIL, gō'bēl', **Antoine,** French missionary to China: b. Gaillac, 1689; d. Pekin, 1759. In 1704 he entered the Jesuit order and in 1723 accompanied several members of the order to China. There he became wonderfully proficient in the languages of the natives; gained a place at court, and by his influence with the emperor saved the Jesuits from the troubles which befell other missionary bodies. The emperor made him official interpreter and director of the imperial colleges. He carried on diplomatic correspondence with Russia and was elected member of the Saint Petersburg Academy. He also was correspondent of the Académie des Sciences de Paris. His works include 'Histoire de Gentchiscan et de toute la dynastie des Manchoux' (1739); 'Traité de chronologie chinoise' (published 1814); translation of 'Le Chou King' (1771), and miscellaneous articles in Rémusat, 'Nouveaux mélanges asiatiques.'

GAUCHOS, gow'chōz, hybrid inhabitants of Argentina, South America, mostly cattle-raisers or cowboys of nomadic habits. They are natives of the pampas, and descendants of Spaniards and Indians. The white strain has largely faded out from them, and a modified Indian type has been developed which has an ethnological interest. As a distinct people, however, they may be said to be disappearing. They are now mainly confined to the Chaco region. Many of them possess figures and bearing which show a proud descent. They wear a costume picturesque in fashion and color, and their skill as horsemen and in using the lasso and bolas is remarkable. They are noted for their hardiness, bravery and free mode of existence. Consult Koebel, W. H., 'Modern Argentina' (Boston 1912); Temple, Sir Edmond, 'Travels in Various Parts of Peru' (London 1830).

GAUDEN, gä'dĕn, **John,** English bishop: b. Mayland, Essex, 1605; d. 2 Sept. 1662. In the early part of his life he belonged to the popular party. After the outbreak of the Civil War he hesitatingly submitted to the Presbyterian discipline, omitted the liturgy from the Church service and even subscribed to the covenant, although he secretly wrote a treatise against it. After the Restoration he was appointed chaplain to Charles II, and successively created bishop of Exeter and of Worcester. He claimed the authorship of the 'Eikon Basilike,' or the 'Portraiture of his Sacred Majesty in his Solitudes and Sufferings,' a work which was once almost universally attributed to Charles himself, and which in one year went through 50 editions. Hallam and Sir James Mackintosh pronounce his claim valid. He seems to have been somewhat in favor of the Commonwealth in the beginning; but their excesses soon estranged him and later disgusted him. He was a voluminous writer and left some 15 volumes. Among his best-known works are 'Cromwell's Bloody Slaughter House' (1660); 'Tears of the Church' (1659). (See Eikon Basilike). Consult Almack, E., 'Biography of the King's Book' (London 1896); Broughton, W. G., 'A Letter to a Friend' (1826); 'Additional Reasons' (1829); Scott, E. J. L., 'Introduction to reprint of his edition of Icôn Basilike' (1880); Todd, H. J., 'A letter to the Archbishop of Canterbury concerning the Icôn Basilike' (1829); Wordsworth, C., 'Who Wrote Icôn Basilike?' (1829).

GAUDRY, gō'drē', **Jean Albert,** French palæontologist: b. Saint Germain-en-Laye, 16 Sept. 1827; d. 27 Nov. 1908. In 1852 he made explorations in Cyprus and Greece and from 1855 to 1860 resided in the latter country. At Pikermi he investigated the deposit of fossil vertebrata and uncovered notable mammalian fauna of the Miocene period. He had already in 1853 been appointed assistant to d'Orbigny in the chair of palæontology of the Paris Museum of Natural History. He became full professor in 1872 and 10 years later was elected member of the Academy of Sciences. In 1900 he presided over the Eighth International Congress of Geology at Paris. His studies in fossil mammalia did much to support the theory of evolution. His works are 'Anmaux fossiles et géologie de l'Attique' (2 vols., 1867); 'Cours de paléontologie' (1873); 'Animaux fossiles du Mont Lebéron' (1873); 'Les Enchainements du monde animal dans les temps géologiques' (1878–90); 'Essai de paléontologie philosophique' (1896). Consult memoir in *Geological Magazine* (1903, p. 49).

GAUERMANN, gow'ĕr-män, **Friedrich**, Austrian painter: b. Wiesenbach, Lower Austria, 20 Sept. 1807; d. Vienna, 7 July 1862. He studied landscape painting under the direction of his father, a landscape painter of merit, and copied the works of the best animal painters from the galleries of Vienna. He also made tours in Styria and the Tyrol. In 1824 he exhibited two animal pieces and in 1826 received commissions from Prince Metternich and the French Ambassador at Vienna. In 1829 he exhibited 'The Storm' which at once won him general recognition. It was followed by 'The Field Laborer' and now his work commanded high prices and was much sought after. Other notable works by him are 'Vultures Hovering above a Wounded Deer'; 'Husbandmen Ploughing'; 'Cows, Horse and Sheep'; 'Well in the Tyrol.' Very many of his animal studies are in the Vienna Academy. Many of his pictures have been engraved.

GAUGE, gāj, the name of many different instruments and appliances used for measuring various dimensions, forces, etc. The various kinds of gauge are distinguished by means of special names indicating the use to which they are applied. Among the most important contrivances of this nature are the instruments fixed to engine boilers for registering the force of the steam and the level of the water. In one of its simplest forms the pressure or steam gauge consists of a bent siphon-tube, with two unequal legs, partly filled with mercury. The top of the shorter limb is connected to a short pipe, which enters that part of the boiler which contains the steam; the other end is open to the atmosphere. A stop-cock is generally placed between the gauge and the boiler, so that it may be put in communication with the boiler at pleasure. When the stop-cock is open, the steam, acting on the mercury in one leg of the gauge, presses it down, and the mercury in the other leg rises. The difference between the two columns is the height of mercury which corresponds to the excess of the pressure of the steam in the boiler above the pressure of the atmosphere. For high-pressure engines, however, the steam-gauge usually works in the manner of an aneroid barometer, a pointer moving on a circular scale under the influence of the motion of a corrugated diaphragm; or, as in the Bourdon gauge, the tendency of a bent tube to straighten itself under the influence of the steam pressure communicates movement in a similar manner to a pointer or index hand. The water-gauge is a vertical glass tube called a gauge-glass, communicating above and below with the boiler. The gauge-glass is not fixed directly to the boiler, but to a brass column known as the gauge-column, communicating with the boiler by two copper tubes of considerable length, the upper leading to the steam space and the lower to the water space. These tubes are fitted with cocks or valves. Two gauge-glasses of different lengths are sometimes fitted to the one column. Gauge-cocks are used as checks on the water-gauges. There are usually three of them on the front of the boiler, one at the normal level of the water, one above and one below. As applied to railroad the term gauge signifies the clear distance between the rails. The usual distance in the ordinary or narrow gauge is four feet eight and one-half inches. The broad gauge of the Great Western Railway of England was formerly seven feet; the Irish, Indian and Spanish gauge is five feet six inches. Special narrow gauges have been adopted for certain lines, especially for mountain and mineral lines, such as the three feet six inch Norwegian gauge. Gauge is also the name applied to various contrivances for measuring any special dimension, such as the wire-gauge, an oblong plate of steel, with notches of different widths cut on the edge, and numbered, the size of the wire being determined by trying it in the different notches till one is found which it exactly fits. The thickness of sheet-metal is tried by a similar gauge. See ANEMOMETER; CALIPERS; RAILWAYS.

GAUGUIN, gō'găn', **Paul**, French painter: b. Paris, 17 June 1848; d. Isle of Dominique, 9 May 1903. His mother was a Peruvian and the future artist was brought up at Lima and in his grandfather's home at Orléans. From 1865 to 1871 he spent his time at sea visiting many parts of the world. For a time he engaged in banking and in his leisure moments took up painting as a hobby. He at length joined the Impressionists and was soon recognized as the most radical of the group. He painted many landscapes of Brittany and southern France, but the most noteworthy work of this first period is 'The Yellow Christ.' In 1891, becoming disgusted with civilization and its artificiality, Gauguin went to Tahiti and for two years lived in the manner of the natives. There he painted a Tahitan series, including the 'Maori Venus'; 'Spirit of the Dead'; 'Maori Women,' which when exhibited at Paris created a furore. Several of his works were exhibited at New York in 1913. He returned to Tahiti in 1895. Consult De Rotonchamp, 'Paul Gauguin' (Weimar 1906).

GAUL, gâl, **Alfred Robert**, English composer and organist: b. Norwich, England, 1837; d. 1913. He was chorister and assistant organist of Norwich Cathedral 1846–59, and subsequently organist of Saint Augustine's Church, Edgbaston, Birmingham. He composed an oratorio, 'Hezekiah'; the cantatas 'Ruth' (1881), 'First Psalm,' 'Ninety-sixth Psalm,' 'Holy City' (1882), a widely popular work; 'Passion Music'; 'The Ten Virgins' (1890), dedicated to the choirs of America; 'Song of Life'; 'Una,' etc.

GAUL, Gilbert William, American historical and genre painter: b. Jersey City, N. J., 31 March 1855. He studied under J. G. Brown and was a pupil of the National Academy of Design, of which he became a member in 1882. He painted many genre pictures, such as 'Indian Girl' (1880); 'Old Beau' (1881), but is at his best in his battle pictures of the Civil War, which are characterized by clever coloring, notable dash and spirit and great truthfulness of detail. Among the best are 'Charging the Battery'; 'Saving the Colors'; 'Battery H in Action' (Toledo Museum); 'Exchange of Prisoners' (Democratic Club, New York). Among his more recent paintings are 'Golden Prospects' (1910); 'Sioux Indian' and 'Loot' (1911); 'Ration Day' and the 'Peace Conference' (1912). He also paints landscapes and has achieved considerable success in this field also.

GAUL, GALLIA, the country of the Gauls, which extended in the times of the Romans, from the Pyrenees to the Rhine, and on the side of Italy, beyond the Alps to the Adriatic. It was divided into Gaul on this side (the Italian side) of the Alps (Gallia Cisalpina), and Gaul beyond the Alps (Gallia Transalpina).

Gallia Cisalpina, which extended from the Alps to the Adriatic Sea, and consequently comprised all Upper Italy as far as the Rubicon and Macra, on account of its adoption of the Roman toga was called *Gallia Togata*. It was divided into Liguria; Gallia Transpadana; Gallia Cispadana. Liguria was inhabited by the Ligurians, Gallia Transpadana principally by the Taurinians, Insubrians, and Cenomani; Gallia Cispadana by the Boii, Senones, and Lingones, all of them nations of Gallic descent.

Transalpine Gaul was also called *Gallia Comata* in distinction from *Gallia Togata*, because the inhabitants wore their hair (*coma*) long, or *Gallia Braccata*, because, particularly in the southern parts, they wore a peculiar kind of breeches (*braccoe*). Cæsar, who conquered Transalpine Gaul at a later period, found it divided into three parts: Aquitania, extending from the Pyrenees to the Garonne, chiefly occupied by Iberian tribes; Gallia Celtica, from the Garonne to the Seine and Marne; Gallia Belgica, in the north, extending to the Rhine.

The Gauls were the chief branch of the great original stock of Celts. On the whole, a strong resemblance appears to have existed among all the Celts. And although they were divided into numerous tribes, there were but few branches that were perceptibly different from each other. It is probable that coming from the east, they took their way along the south side of the Danube, having the numerous nation of the Thracians in their rear and the Germans on their side; but the period of this event is so remote that we cannot even venture a conjecture in regard to it.

A too great population (which is not uncommon in half savage and partly nomadic nations whose means of supplying their wants are very imperfect, and who require a great extent of country), and the pressure of German and Thracian tribes, caused general migrations among the Gauls about 397 B.C. Colonies from many tribes took their course over the Alps into Italy, and eastward along the Danube. This passage of the Celtic Gauls over the Alps first brings that nation into the region of history.

Our accounts of the course of the eastern Gauls along the banks of the Danube are very imperfect. This, however, is evident, that their movements occasioned the migrations of whole nations. One hundred years after the burning of Rome, the eastern Gauls, from 280–278 B.C., made three destructive irruptions into Macedonia and Greece, which had already been depopulated by former wars. Ptolemy Ceraunus, king of Macedonia, and Sosthenes, the commander of the army, fell in battle, and Greece trembled. But in an attack on the temple of Apollo at Delphi (which contained immense treasures, but was protected by its situation) the terrors of religion and the assaults of the elements (tempest and hail-storms) came over them; they were defeated, and hunger, cold, and the sword of the Greeks completed their destruction. Several tribes pursued their course into Asia Minor, where, under the name of Galatians, they long retained their national peculiarities, and preserved their language even to the latest period of the empire. The reaction of these migrations upon Gaul itself appears to have been considerable. The Gauls along the banks of the Danube and in the south of Germany disappear from that time. Tribes of German origin occupy the whole country as far as the Rhine, and even beyond that river. The Belgæ, who were partly German, occupied the northern part of Gaul, from the Seine and Marne to the British Channel and the Rhine, from whence colonists passed over into Britain, and settled on the coast districts. The Celtæ in Gaul attained a higher degree of cultivation, to which probably their intercourse with the Greeks in Massilia (Marseilles), whose letters they used in writing their own language, and with the Carthaginians, in whose armies they frequently served as mercenaries, contributed in a great measure. But they were then hardly able to resist the Germans who lived on the other bank of the Rhine. Their kinsmen, the Britons, who fought from chariots, and practised polygamy, were more fierce than the Gauls.

Meanwhile the Gauls of Cisalpine Gaul had taken up their residence in the fertile plains of Upper Italy. Rome trembled at the irruption of these barbarians into Italy; but Caius Marius saved the republic. In two bloody battles, at Aix (Aquæ Sextiæ) in 102, and at Vercelli in 101 B.C., he destroyed these nations. Only that portion of them which had remained in Gaul to await the issue of the expedition escaped the general ruin. Forty-three years after this event Caius Julius Cæsar received the proconsulship over the countries bordering on Gaul. He resolved to subject all Gaul, and executed his purpose in less than nine years (58–50 B.C.), in eight bloody campaigns.

The religion of the Druids, being suppressed in Gaul by Tiberius and Claudius, it gradually retreated into Britain, where, particularly on the small islands near the British coasts, the priests established their mysterious rites, of which in ancient times strange and dreadful accounts were current. The Britons also were soon conquered by the Romans. After the extinction of the family of the Cæsars, the Gauls once more made an attempt to recover their liberty by the aid of the Germans, but in vain. After this last effort they gradually became Roman citizens, and so entirely Romanized that even their ancient language, the Celtic, was supplanted by a corrupt Latin dialect, retaining, however, a considerable number of Celtic words, especially as roots, which, intermingled with Franco-Germanic words, formed the modern language. About the year 486 the Franks subdued the greater part of Gaul, and put a period to the dominion of the Romans in that country.

Bibliography.— Despardins, 'Géographie historique et administrative de la Gaule romaine' (Paris 1877); Fustel de Coulange, 'Histoire des institutions politiques de l'ancienne France' (Paris 1877); Goodwin, 'History of France' (New York 1860); Holmes, 'Cæsar's Conquest of Gaul' (Oxford 1911); Marin de Syr, 'La France avant César' (Paris 1865); Martin, 'Histoire de France' (Paris 1865); Roget, 'Ethnogénie gauloise' (Paris 1868–75); Sihler, 'Annals of Cæsar' (New York 1911); Thierry, 'Histoire des Gaulais' (Paris 1872).

GAULEY BRIDGE, W. Va., an important strategical point at the head of Kanawha Valley, and one of the three passes of the Alleghanies. It was the objective point of General Cox in his campaign from the Ohio in July 1861, and was occupied by him and strongly fortified after he had driven General Wise from the valley and eastward to Lewisburg. After the battle of Carnifax Ferry Rosecrans advanced to Sewell Mountain, confronted General Lee, who had assumed command of the Confederate forces, for several days, and then fell back to Gauley Bridge, disposing the greater part of his army from 5 to 12 miles in front of it, along the Lewisburg road. With Lee's assent General Floyd, with about 5,000 men, crossed New River and moved down its south side to Cotton Hill, a bold height in the angle formed by the junction of the New and Gauley rivers. He got artillery in position commanding Gauley Bridge, the ferry across the Gauley and the road leading to Rosecrans' camps. On the morning of 1 November the artillery opened fire, sunk the ferryboat and, with sharpshooters beyond New River, stopped the passage of Rosecrans' supply-trains. The contest on both sides, with artillery and musketry, across the narrow river was severe, and ended only by darkness. The next day it was resumed and continued for 10 days, the trains moving only by night. Meanwhile Rosecrans was preparing to capture Floyd by moving a force on his left and rear, a movement in which Cox, who was in command at Gauley Bridge, was to co-operate. On the 10th Cox crossed his brigade in boats over New River, at and near its mouth, and drove Floyd from Cotton Hill, after a sharp fight of two days. The co-operative movement on Floyd's left and rear failed. Floyd became aware of it, and on the 12th retreated as rapidly as possible, abandoning wagons and supplies, and pursued as far as Fayetteville. He continued his retreat to Dublin, on the Virginia and Tennessee Railroad.

GAULEY MOUNTAINS, W. Va., a range in Pocahontas and Randolph counties, with an altitude of about 4,000 feet. There is a lower ridge in Kanawha and Fayette counties extending eastward for about 30 miles, from the Kanawha River near Charleston which bears this name also. The maximum altitude of the lower ridge is about 2,000 feet.

GAULEY RIVER, W. Va., an affluent of the Great Kanawha River. It rises in the Black Mountains in Pocahontas County, and after a course of 75 miles, first westward between the Gauley Mountains (q.v.), then southward, joins New River which, from the point of junction at Gauley Bridge, is called the Great Kanawha, a tributary of the Ohio.

GAULS. See GAUL; FRANCE.

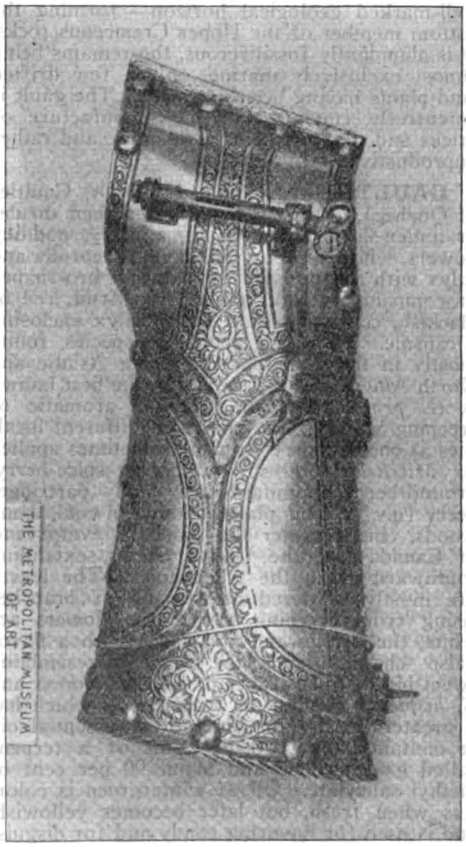
GAULT, gâlt (originally a local name in Cambridgeshire, England, for clay), one of the subdivisions of the Cretaceous system (q.v.). The gault is a stiff, bluish-gray clay, which here and there contains indurated nodules and septaria. Now and again it becomes somewhat calcareous, or sandy and micaceous. In some parts of Sussex a band of phosphatic nodules occurs at its base. The deposit is of variable thickness — reaching in some places over 300 feet, while occasionally it hardly attains a greater thickness than 50 feet, and forms a well-marked geological horizon — forming the bottom member of the Upper Cretaceous rocks. It is abundantly fossiliferous, the remains being almost exclusively marine, only a few drifted land-plants having been met with. The gault is extensively employed in the manufacture of bricks and tiles; it forms a retentive and rather unproductive soil.

GAULTHERIA (named for Dr. Gaultier of Quebec), a large genus of evergreen shrubs, or under-shrubs, with small, axillary, nodding flowers, white, pink or red, having a corolla and calyx with five divisions, the former urn-shaped or companulate; and a berry-like fruit, red or blackish, consisting of a fleshy calyx enclosing a capsule. There are about 100 species, found mostly in the Andes, a few being Asiatic and North American. Of the latter, the best known is *G. procumbens,* the familiar aromatic or creeping wintergreen, known in different localities as checkerberry (a name sometimes applied to *Mitchella repens*), boxberry, spice-berry, ground-berry, mountain tea and partridge-berry (q.v.). This plant is found in cool, damp woods, chiefly under the shade of evergreens, in Canada and the United States, extending southward along the Alleghanies. The leaves are mostly clustered at the top of branches rising from creeping stems; the flowers are white, the berries red and spicy, with a flavor (also characterizing the leaves) resembling sweet birch. The leaves of *G. procumbens* and *G. hispidula* contain an aromatic oil which has a greater density than any other essential oil. It contains about 10 per cent of a terpene called gaultherilene and about 90 per cent of methyl salicylate. Oil of wintergreen is colorless when fresh, but later becomes yellowish, and is used for flavoring candy and for disguising the taste of unpleasant medicines. This oil may be extracted from a few other plants, particularly sweet birch (*Betula lenta*). See WINTERGREEN.

GAUNT, John of. See JOHN OF GAUNT.

GAUNTLETS (spelled also *gantlets*). A defensively armored glove. Before the 14th century already the sleeves of the chain mail hauberk had become extended over the hand, and, through an opening in the palm side, the hand could be extracted, leaving the hand free and the glove part hanging like a pouch. By the beginning of the 14th century gauntlets were in use (rarely) made up of scales of leather, metal or horn on the upper surface. About 1330 the separate armored gauntlet was in frequent use as an integral piece of armor.

Steel plates were now being fastened to the leather glove; they belong to the «splint» armor period. By 1335 the wrists were armed with splints. While the digits were jointed circlets of metal, a series of wider transverse plates covered the main portion of the back of the hand. By 1337 the back of the hand, from knuckles to well up the wrist, was protected by a single broad plate formed to the parts. Inside this was a leather glove whose fingers and thumb piece on the upper side had protection of overlapping plates; a style that gave satisfaction, apparently, for about a hundred years. An offensive addition to some gauntlets was made about this time, by producing sharp



German Late Sixteenth Century Gauntlet

points or knobs on the knuckles; they were termed «gads» or «gadlyngs.» Historical incidents are recorded of most effective, stunning blows being given with these formidable offensives. The defective open space between the single broad plate protecting both wrist and knuckles seems to have been eradicated about 1400 by rivetting the glove to the plate. By the 15th century the knuckle part was made of a separate plate articulated by rivets to the wrist-piece. By about 1433 this broad-plate gauntlet had fallen into disuse, being displaced by the steel «miton» with a «cuff» pointed on its arm end. The «miton» then was a gauntlet having the digits armed by one piece of metal — the fingers no longer separated.

Single Gauntlets.— There were several kinds of gauntlets made to wear *singly*. One was the «close» or «tourneying» gauntlet (sometimes erroneously termed «forbidden» gauntlet). This had the furthest finger-plate extended so as to reach and overlap the inside of the wrist-piece, when folded over. The proceeding was, after grasping the sword, to «close» this long finger-piece around the hilt and fasten it with a turning pin working in a hole in the plate. The quillons (see SWORDS) of the sword or tourney club thus prevented the weapon from being forced backward through the hand and the pommel prevented it from being pulled out. Another single gauntlet was the «manifer» or «main-de-fer,» a heavy metal hand defense for holding the horse's bridle. The «barriers'» gauntlet, as the name implies, was to protect the hand from being crushed in combat when knights tilted with barriers between them. In the 17th century we come across gauntlets reverting to the separate armed fingers; the «elbow» gauntlet of this century had a «cuff» that extended the whole length of the forearm. A specially constructed gauntlet was used for seizing the opponent's sword. Among the sports of the nobles of those days was bird hunting with falcons or hawks, and the «falconer» had his specially devised gauntlet for holding and releasing the bird of prey. The throwing down of the knight's gauntlet was a «gage» or challenge to combat.

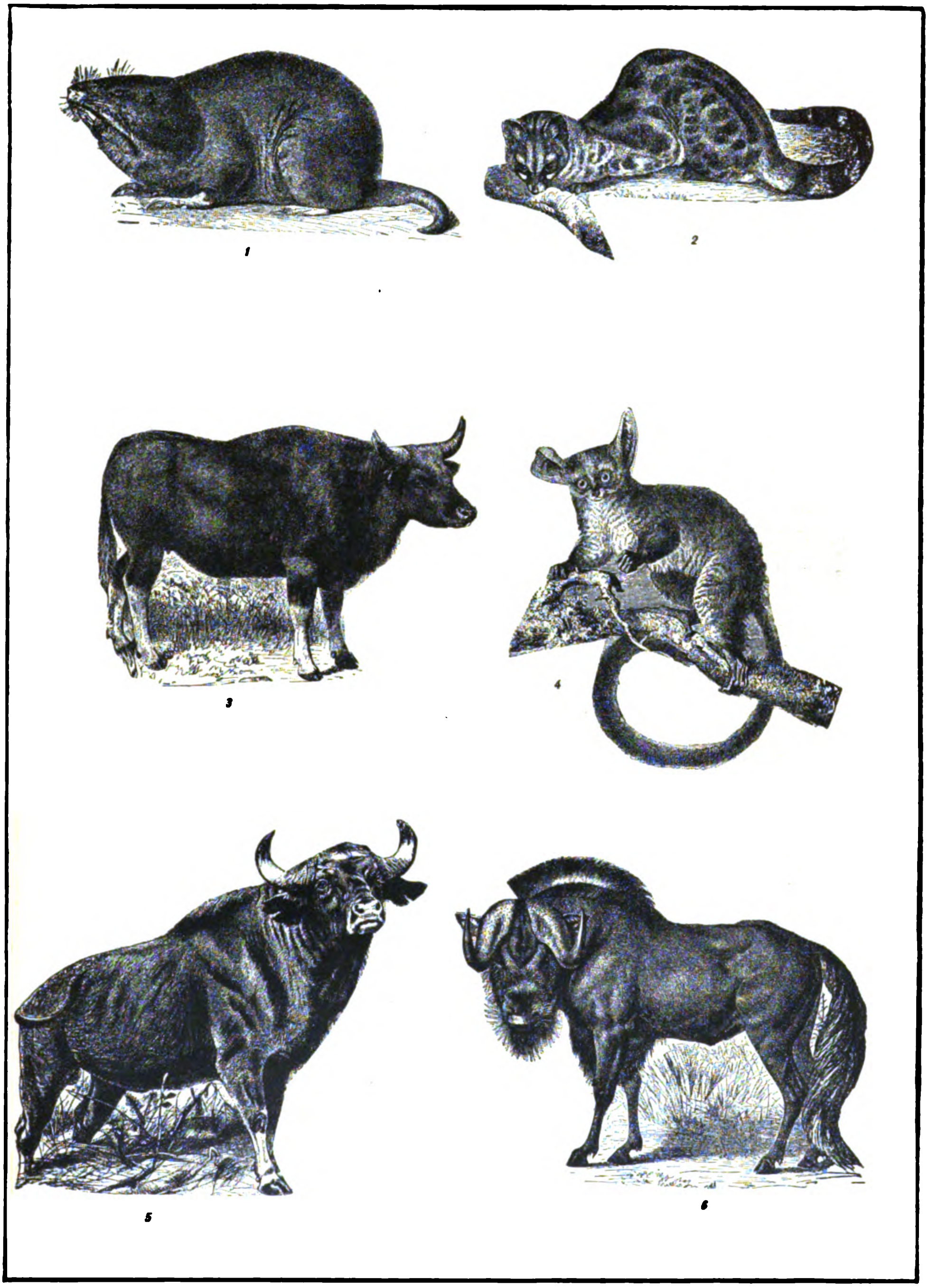
Bibliography.— Cosson, Baron de, 'On Gauntlets' (in *Archæological Journal,* London 1884); Dillon, Viscount, 'Single Gauntlets' (in *Archæological Journal,* London 1913). See also bibliographies under titles CHAIN ARMOR; PLATE ARMOR.

CLEMENT W. COUMBE.

GAUR, gowr, a very large, fierce and untamable ox (*Bos gaurus*) found in the forests of India and Burma, called «bison» by Anglo-Indian sportsmen, and distinguished by the Malays into two varieties called «sladang» and «sapio.» Old bulls are sometimes six feet high at the shoulders, making them the largest of wild oxen. The horns spread laterally and curve upward to the length ordinarily of 20 to 30 inches, and are large and flattened, while the ridge of the forehead between them leans forward decidedly and is covered with a mop of gray hair. The general color is smooth, shining, blackish brown, with the feet white. This magnificent animal, which is semi-domesticated to some extent in northern India and never in the south, wanders about the jungles in small shy herds under the leadership of a powerful bull, as is the habit of forest oxen generally. It is one of the foremost objects of rifle sport in India, and the best accounts of its habits are to be found in the books of sportsmen-writers, such as Baker, Kinloch, Shakespeare, Hornaday, etc. The animal must be followed on foot, in which the aid of good trackers is essential; and when it has been overtaken it is usually hidden in some dense cover, whence it is likely to charge without warning. Its flesh is excellent. See GAYAL.

GAUSS, gows, **Karl Friedrich,** German mathematician: b. Brunswick, 30 April 1777; d. Göttingen, 23 Feb. 1855. At 18, while a student at Göttingen, he solved a problem (that

GAUR, GENET, ETC.



1 Gopher (Geomys bursarius)
2 Genet (Viverra genetta)
3 Gayal (Bos frontalis)
4 Galago (Otolicnus galago)
5 Gaur (Bos gaurus)
6 White-tailed Gnu (Connochaetes gnu)

of the division of the circle into 17 equal parts) which had occupied geometers from the time of Euclid. In 1801 was published his 'Disquisitiones Arithmeticæ,' treating of indeterminate analysis or transcendental arithmetic, and containing, in addition to many new and curious theorems, a demonstration of the famous theorem of Fermat, concerning triangular numbers. He calculated, by a new method, the orbit of the newly discovered planet Ceres, and afterward that of Pallas, for which he received from the French Institute in 1810 the medal founded by Lalande. In 1807 he became professor of mathematics and director of the observatory at Göttingen, a position which he held till his death. In 1821, being charged by the government of Hanover with the triangulation of that country and the measurement of an arc of the meridian, he rendered the most distant stations visible by means of the heliotrope, an instrument of his invention for reflecting solar light; and in connection with Weber made valuable investigations concerning terrestrial magnetism. He was pronounced by Laplace to be the greatest mathematician in Europe. Among the more celebrated of his works are 'Theoria Motus Corporum Cœlestium' (1809); 'Intensitas Vis Magneticæ Terrestris' (1833); 'Dioptrische Untersuchungen' (1841); and 'Untersuchungen über Gegenstände der höheren Geodesie' (1844). Consult Schering, E. J., 'Gauss's Collected Works' (Göttingen 1863–71).

GAUSSEN, gow'sĕn, **Louis**, Swiss theologian: b. Geneva, 25 Aug. 1790; d. Les Grottes, 18 June 1863. He was appointed pastor of Satigny in 1816. A close follower of the early Calvinists he refused to adopt the new catechism which the consistory introduced. He was censured by the Geneva ministers and was deposed in 1832. In this year, with two others, he founded a society for the dissemination of Bibles and other religious literature. Four years later he was made professor of theology at the Evangelical School of Geneva. He wrote 'Theopneustics' (1841); 'It is Written' (1856); 'Lessons for the Young on the Six Days of Creation' (1860); 'Canon of Scripture' (1862).

GAUTAMA, gow'tą-mą, or **GOTAMA**, the patronymic of several celebrities connected with Hindu Vedaism, and of Siddartha Gautama, the founder of Buddhism. See BUDDHA.

GAUTHEROT, gōt'rō, **Gustave**, French educator and author. He was educated at the College of Mont Roland and the universities of Dijon and Paris. He was professor of history at the College of Vaugirard, Paris, and afterward became professor of the history of the French Revolution at the Institut Catholique de Paris. In 1914–16 he was commandant of the 29th Infantry Regiment, and in 1917 was made captain of the Etat-Major of the 5th Army. He has published 'Histoire de la Révolution Française dans l'ancien Evêché de Bâle' (1908), crowned by the French Academy; 'Les relations Franco-helvétiques de 1789 à 1792' (1908); 'L'échange des otages sous la Commune' (1910); 'La question de la langue auxiliaire internationale' (1910); 'Gobel, Evêque métropolitain constitutionel de Paris' (1911); 'L'Assemblée Constituante' (1911); 'La journée du Dix Août, 1792, et la Marseillaise' (1912); 'La Démocratie Révolutionnaire' (1911); 'L'Epopée Vendéenne' (1913), which was crowned by the French Academy; 'Le Vandalisme Jacobin: Destructions administratives d'archives, d'objets d'art, de monuments religieux à l'epopée révolutionnaire' (1914); 'L'Agonie de Marie-Antoinette' (1914). He contributed to the 'Catholic Encyclopedia' and to *La Croix, L'Univers, Revue des questions historiques, Revue Française, Revue pratique d'apologétique*, etc.

GAUTHIER, gō'tē'ā', **Charles Hughes**, Canadian prelate: b. Alexandria, Ontario, 3 Nov. 1845. He was ordained to the priesthood in 1867; consecrated archbishop of Kingston (Roman Catholic), 29 July 1898, and was translated to the archiepiscopal diocese of Ottawa in September 1911.

GAUTIER, gō'tyā, **(Charles) Lucien**, Swiss theologian: b. Cologny, 1850. He received his education at the universities of Geneva, Leipzig and Tübingen. From 1877 to 1898 he was professor of Old Testament exegesis and Hebrew at the University of Lausanne. He presided at the synod of the Vaudois Eglise libre in 1885, 1886, 1891 and 1892. To his travels in the Holy Land in 1894 and 1899 we owe several interesting volumes. His works include 'Au dela du Jourdain' (1895); 'Souvenirs de Terre-Sainte' (1898); 'Autour de la Mer Morte' (1901); translation of Ghazali's 'Ad-Dourra el-Fâkhira' (1878); 'Le sacerdoce dans l'Ancien Testament' (1874); 'La mission du prophète Ezéchiel' (1891); 'Vocations des prophètes' (1901); 'Introduction à l'Ancien Testament' (1906); 'La loi dans l'ancienne Alliance' (1908); 'L'Evangeliste de l'Exil' (1911).

GAUTIER, Emile Théodore Léon, French scholar and critic: b. Havre, 8 Aug. 1832; d. 1897. He was educated at Laval and at the Collège Sainte-Berbe de Paris. He held official positions connected with the schools and libraries of his native place till his growing eminence as a writer brought him to Paris. In 1886 he became chief secretary of the national archives and in 1887 was chosen member of the Institute. His works, which place him among the very foremost authorities on mediæval European literature, include 'Scènes et nouvelles catholiques' (1861); 'Quelques mots sur l'étude de la paléographie et de la diplomatie' (1858; 3d ed., 1864); 'Definition Catholique de l'Histoire' (1860); 'Benóit II' (1863); 'Etudes litteraires pour la défense de l'eglise' (1864); 'Études historiques pour la défense de l'église' (1864); 'Epopées françaises' (1866–67); 'Vingt nouveaux portraits' (1878); 'La Chevalerie' (1884); 'Histoire de la poésie religieuse dans les cloitres des IXe et XIe siècles' (1888); 'Etudes et tableaux historiques' (1890); 'Bibliographie des Chansons de Geste' (1897).

GAUTIER, Judith, French novelist, daughter of Théophile Gautier (q.v.) and Carlotta Grisi, the famous Italian singer: b. Paris, France, 1850. She married Catulle Mendès, but was divorced from him and in 1913 married Pierre Loti, the celebrated novelist. Her first work, under the name "JUDITH WALTHER," was 'The Book of Jade' (1867), a collection of prose and verse translated from the Chinese; it was followed by ‘The Imperial Dragon’ (1869), a Chinese romance, signed "JUDITH MENDÈS"; ‘The Usurper,’ a Japanese romance, crowned by the French Academy in 1875; ‘Lucienne’ (1877); ‘The Cruelties of Love’ (1878); ‘Isoline’ (1881); ‘Poems of the Dragon Fly’ (1884), adapted from the Japanese; ‘Potiphar's Wife’ (1884), a Persian romance; ‘The Merchant of Smiles’ (1888), a drama adapted from the Chinese; ‘The Marriage of Fingal’ (1888), a lyric poem; ‘Les Princesses d'amours’ (1900); ‘Parsifal’ (1908); ‘L'avare Chinois’ (1908); ‘Collier des jours’ (1908); and in collaboration with Pierre Loti, ‘La fille du ciel’ (1912). This work was translated and produced under the title ‘Daughter of Heaven’ at the Century Theatre, New York.

GAUTIER, Théophile, French poet and prose writer: b. Tarbes, France, 31 Aug. 1811; d. Paris, 23 Oct. 1872. He was educated at the grammar school of his native town, and afterward at the College Charlemagne in Paris. He applied himself at first, but without much success, to painting; and then turned to literature. In verse he published ‘Albertus’ (1830); ‘Comedy of Death’ (1832); ‘Enamels and Cameos’ (1856), his best poetry, etc. His novels and short stories include ‘Young France’ (1833); ‘Mademoiselle de Maupin’ (1835); ‘Fortunio’ (1838); ‘A Tear of the Devil’ (1839); ‘Militona’ (1847); ‘The Tiger's Skin’ (1852); ‘Jettatura’ (1857); ‘Captain Fracasse’ (1863); ‘Handsome Jenny’ (1865); ‘Spirite’ (1866), etc. He was drawn early to feuilleton writing, and for more than 30 years contributed to the Paris newspapers criticisms on the theatre and the salon. He also wrote ‘Journey in Spain’ (1843); ‘Zigzags’ (1845); ‘Constantinople’ (1854); ‘Journey in Russia’ (1866), etc., which rank among the most delightful books of modern travel. Still other works were an enlarged edition of ‘Enamels and Cameos’ (1872); ‘The Grotesques’ (1844); ‘History of Dramatic Art in France’ (1859); ‘Balzac’ (1858); ‘Private Menagerie’ (1869), biographical; ‘History of Romanticism’ (1872); ‘Literary Portraits and Souvenirs’ (1875); ‘The East’ (1877), the last two being posthumous. Gautier's whole philosophy is a philosophy of paradox, his ideal of life hardly more than a picturesque viciousness. His besetting sin was a desire to say something clever and wicked to shock the Philistines. (See MADEMOISELLE DE MAUPIN). He was one of the most interesting figures in the literary world of Paris in his day; was cosmopolitan in his tastes and employed a style remarkable for its faultlessness. His frank expression of hedonism and his contempt for the common canons of morality as expressed in many of his works kept the Academy forever closed to him. Consult lives by Feydeau (1874); Bergerat (1878); Richet (1893); Brunetière, ‘Évolution de la poésie lyrique’ (1894); Du Camp (1890); also Deschamps, ‘La vie et les livres’ (Paris 1900); Faguet, ‘Le XIXe Siècle’ (ib. 1894); Henriot, E., ‘Théophile Gautier, poète’ (in *Annales Romantiques,* 1912); Huneker, J. G., ‘The Pathos of Distance’ (New York 1913).

GAUTIER DE COSTES. See CALPRENÈDE.

GAUTSCH VON FRANKENTHURN, gowtsh fōn fränk'en-toorn, **Paul,** BARON VON, Austrian statesman: b. Vienna, 1851. He was educated at the University of Vienna. He entered the service of the Department of Education in 1874, and from 1885 to 1893 served as Minister of Education in Taafe's Cabinet. From 1895 to 1897 he was again Minister of Education under Premier Badeni, and in 1897–98 succeeded his chief, and also held the portfolio of Minister of the Interior. He next served as president of the Supreme Court of Accounts and at the end of 1904 became Premier in succession to Koerber. He developed a scheme for universal suffrage which failed of passage and resulted in the fall of his cabinet in May 1906. He was a second time Premier from 26 June to 31 Oct. 1911.

GAUZE (French *gaze,* Middle Latin *gazzatum*), a light, transparent silk stuff, or sometimes a fabric of silk and cotton or silk and hemp, or of other material. In weaving gauze, at every third cast of the shuttle the warp-threads are turned or twisted after receiving the woof from right to left, and the reverse, alternately, between each throw of the shuttle, so that the weft-threads are separated from each other, the slight texture being thus produced. Gauzes are either plain or figured. The latter are worked with flowers of silver or gold, on a silk ground, and are chiefly made in China. For antiseptic purposes, etc., cotton gauze is specially made for the use of surgeons. Special fabrics to which the name is given are also manufactured to be made into light underwear. The term has further been extended to any slight open material, as bolting-cloth and wire-cloth for various purposes. A wide-meshed, unsized cheese-cloth, which is called gauze, is considered by surgeons to be the cheapest and most convenient material for dressing wounds, being comfortable and absorbing fluid without disagreeable matting.

GAVAGE, gă'văzh', a method of feeding resorted to when the individual is unable or unwilling to take food in the usual manner. A rubber catheter is employed and is joined by means of a glass tube to a flexible rubber tubing with a funnel at the end. The catheter is inserted and passed into the stomach and the food is poured into the funnel.

GAVARNI (properly SULPICE GUILLAUME CHEVALIER), French caricaturist and illustrator: b. Paris, 13 Jan. 1804; d. 23 Nov. 1866. He came of poor parents, but while apprentice in an engine-building factory, managed to study mechanical and free hand drawing. After many disappointments in his early attempts to market his drawings he succeeded admirably in 1838 in drawing for a fashion journal. He became director of the periodical *Les gens du monde* and from this time his success was meteoric. Financial difficulties put his journal *hors du combat* and himself in prison. After his release he joined the staff of *Le Charivari,* which journal he made a success. He depicted with facile pencil all the foibles of the Parisians. He also illustrated books, among them Sue's ‘Wandering Jew.’ A visit to London in 1849 changed the bent of his work, which hitherto had been laughing and joyous, into a somewhat morose and dismal outlook in human life, caused by his visits to the submerged hosts of London. Consult Mahérault and Bocher 'Catalogue raisonné de l'œuvre de Gavarni' (Paris 1873) and Curtis, 'Masters of Lithography' (New York 1897).

GAVARNIE, Cascade de, France, a waterfall in the Cirque de Gavarnie, Pyrenees. It is the second highest in Europe, being 1,385 feet in height.

GAVARNIE, Cirque de, France, a natural amphitheatre in the Pyrenees. It is 2¼ miles in width and 5,380 feet in height.

GAVAZZI, gä-vät'sē, **Alessandro,** Italian reformer: b. Bologna, Italy, 21 March 1809; d. Rome, 9 Jan. 1889. At 16 he became a monk of the Barnabite order, and subsequently was appointed professor of rhetoric at Naples, where he speedily acquired a reputation as an orator. On the ascension of Pius IX to the papal chair, he devoted himself to the diffusion of political enlightenment and patriotic aspirations among the masses of the Roman population. Later he forsook the papal ranks, and to Gavazzi's fervid and patriotic oratory may be attributed, in no slight degree, the universal spirit of self-sacrifice evoked throughout Italy during this period of her history. He was called Peter the Hermit of the national crusade. On the establishment of the republic at Rome he was appointed almoner-in-chief to the national army. Rome having fallen, Gavazzi went to England, where he delivered numerous addresses and lectures illustrative of the political and religious aims of his country. He twice visited the United States. He was the founder of the Free Christian Church of Italy in 1870, and author of 'Recollections of the Last Four Popes' (1859); 'No Union with Rome' (1871), etc.

GAVELKIND, a system of tenure formerly existing in England and Ireland, now confined to the county of Kent and a few other parts of England. It preceded and survived the feudal system. Its great principle was that the estate descends not to the eldest son but to all the sons, or, in the case of deceased sons, their representatives, in equal shares. It is supposed to be of Celtic origin, was general in Anglo-Saxon times, and at the Conquest was among the «liberties» won from William by the men of Kent. Elsewhere it was superseded by the feudal law of primogeniture. In Wales it survived down to the reign of Henry VIII, and it is not quite extinct yet in some parts of England. In Irish gavelkind the land was not divided among the sons, but reverted to the common stock and was again divided among the surviving members of the tribe. See INHERITANCE; TENURE; and consult Robinson, 'On Gabelkind.'

GAVERE, gă'vr, Belgium, town of the province of East Flanders, about five miles from Ghent. Here in 1453 Philip the Good, Duke of Burgundy, inflicted a severe defeat on the inhabitants of Ghent. There are few manufactures and those that exist are purely local. In August 1914 Gavere was occupied by the Germans in their rush on Paris. Pop. 1,900.

GAVESTON, găv'ĕs-tŏn, **Piers,** favorite of Edward II, king of England: b. 19 June 1312. He was a Gascon by birth, and on account of his father's services to Edward I was chosen companion to the Prince of Wales, over whom he acquired a complete and very mischievous ascendency, wasting his resources and breeding dissension between him and his father. Edward I banished him in 1307, but died the same year, and Edward II at once recalled him, made him Earl of Cornwall, and gave him in marriage his niece, Margaret de Clare. Intoxicated with his elevation and honors Gaveston became intolerably insolent and exasperated the nobles. He was again banished, again recalled, and, the barons having declared war, was captured and executed near Warwick.

GAVIAL, gā'vĭ-ạl, or **GHAVIAL,** the common crocodile of northern India (*Gavialis gangeticus*), characterized by its greatly prolonged and slender snout, a peculiarity which increases with age and varies according to sex. In the male the nose is very much swollen, and can be inflated like a bag when the nostrils (at the extremity) are closed. The teeth are very numerous — usually more than 100. The cranial structures accompanying these peculiarities indicate a separate family (*Gavialidæ*), which first appears in the Upper Cretaceous, and has had many fossil genera and species, among them an Asiatic monster (*Rhamphosuchus crassidens*) of the Pliocene which was 50 feet in length. The gavial inhabits chiefly the basins of the Ganges, Indus and Brahmaputra, and reaches a length of 20 to 25 feet. In the Ganges it is of a deep sea-green color above, with numerous irregular brown spots, smallest and thickest about the jaws, and below pale yellowish white. It feeds on fish and is harmless, in spite of its huge size. Its habits are little known; and still less is known of a closely related but smaller gavial (*Tomistoma schlegeli*) of Borneo and Sumatra.

GAVOTTE, gạ-vŏt, or **GAVOT,** originally a dance of the Gavots or people of the Gap, department of the Upper Alps in France. It was a peasant dance, not unlike a minuet, and happily uniting liveliness with dignity. It was popular from the 16th to the 18th century, and at one period was in favor at court. After undergoing modifications it fell into disuse. The name is also given to a kind of music at first intended for such a dance. It came into great favor and was a frequent movement in suites, sonatas, etc., having been used by Bach and other great composers. In our time it has again become popular.

GAWAIN, gâ'wān, nephew of King Arthur, son of Loth of Orkney, and the most famous hero of the Arthurian cycle. He is supposed to have reigned in Galloway, was dispatched as ambassador to the Roman camp, accompanied Arthur to England and was slain in the battle which took place soon after their landing. Consult Weston, Jessie L., 'The Legend of Sir Gawain'; id., 'Sir Gawain and the Green Knight' (New York 1910).

GAY, Delphine. See GIRARDIN, MADAME DE.

GAY, Edward, American landscape painter: b. Dublin, Ireland, 25 April 1837. His family was compelled to leave Ireland on account of the political difficulties of 1848, and came as refugees to America, settling in Albany, N. Y. As they had become greatly impoverished, the boy never had a day's schooling, but was put to work to earn his living. At an early age he showed great facility in drawing, and some sketches he made on the cellar doors of an office building attracted the attention of James M. Hart and George H. Boughton, who gave him the freedom of their studios. In 1862 he went abroad and studied under Schirmer and Lessing in Carlsruhe, Germany. His first large picture after his return, 'The Suburbs,' was exhibited at the National Academy of Design in 1872 and resulted in his becoming an associate of that body. At the Centennial Exhibition (1876), 'Late Afternoon' won him distinction. Of 'Washed by the Sea,' which was purchased by Mr. Layton and presented to the Layton Museum, Milwaukee, George Inness wrote, "No greater landscape has been produced in America." Some years later his 'Broad Acres' was awarded the prize of $2,000 by the American Art Association, New York, and presented to the Metropolitan Museum of Art. 'Mother Earth' which is to hang in the High School, Mount Vernon, N. Y., was exhibited at the World's Fair, Chicago, and the following year received a medal at the mid-winter exhibition at San Francisco. One of Mr. Gay's finest paintings, 'The Fields at Eastchester,' also hangs in the High School, Mount Vernon. In the Executive Mansion at Albany hangs 'Where Sea and Meadow Meet,' a painting that has met with much praise. In 1903 he was awarded the Shaw Prize by the Academy of Design for the best landscape in the exhibition, 'Miamus River,' and in 1905 the Inness gold medal for the most meritorious landscape in the Academy exhibition. He was made a life member of the Lotus Club for his achievements in art and in 1907 a member of the National Academy. About this time he painted 'Ruins of the Greek Theatre in Taormina, Sicily,' which now occupies a lunette in the Mount Vernon Library, and is perhaps the most popular of his paintings. 'Waving Grain' is owned by the Minneapolis Gallery of Fine Arts, 'Waste Lands' hangs in one of the rooms of the Mount Vernon Library. 'El Dorado'; 'My Lady's Estate'; 'Those Happy Summer Fields'; 'Toilers of the Sea'; and other pictures hang in private galleries. 'The Hillside' hangs in the National Gallery at Washington, D. C., in the William M. Evarts Collection. A picture, perhaps not so well known, called 'The Grain Field' has been presented to the Public Library at Holyoke, Mass. It possesses a compelling quality or soul which attracts the beholder in a wonderful manner and makes him loath to leave it. 'The Acropolis at Athens' was painted for Frank R. Chambers, Esq., and forms a part of the decoration of his library at Bronxville, N. Y.

Mr. Gay sees nature under large and sunny aspects, painting meadows, the flow of rivers, wide orchards in springtime, and great billowy fields of grain in the sunshine or the full light of day. His works have been prominent in the New York Water Color Society, of which he is a member.

GAY, John, English poet and dramatist: b. Barnstaple, Devonshire, England, baptized, 16 Sept. 1685; d. London, 4 Dec. 1732. In 1712 he became secretary to the Duchess of Monmouth, and two years later, to Lord Clarendon, with whom he went to the Continent. After having made considerable money out of his publications, he lost it in South Sea speculations in 1720. Four years later his success in drama relieved his money difficulties. His life was one more or less literary success. In 1713 he published his 'Rural Sports,' which he dedicated to Pope. This compliment introduced them to each other, and proved the foundation of a friendship which lasted for life. In 1714 his caricature of Ambrose Philips' pastoral poetry was published under the title of 'The Shepherd's Week.' His pleasant mock-heroic poem, entitled 'Trivia, or the Art of Walking the Streets of London,' was published in 1715, and in that year also was acted his burlesque drama of 'What d'ye Call It?' followed by a farce, in conjunction with Pope and Arbuthnot, called 'Three Hours after Marriage.' In 1720 he published his poems by subscription, in 1723, his tragedy, 'The Captives,' and in 1726 his well-known 'Fables.' His 'Beggar's Opera' was first acted in 1727 at Lincoln's Inn Fields, where it ran for 63 nights, but the lord-chamberlain refused to license for performance a second part entitled 'Polly.' The latter part of his life was spent in the house of the Duke of Queensberry, where he wrote his sonata 'Acis and Galatea' and the opera 'Achilles.' He was interred in Westminster Abbey, where his monument bears a flippant epitaph taken from one of his letters to Pope. Among his smaller pieces, his two ballads of 'Black-eyed Susan' and ''Twas when the Seas were Roaring,' are much admired. Consult Johnson, 'Lives of the Poets' (London 1854); Thackeray, 'English Humorists' (London 1853).

GAY, Maria, Spanish opera singer: b. Barcelona 1880. Until her 16th year she devoted her attention to sculpture, but in 1897 began her studies of piano. Through a chance meeting with Pugno she was induced to join his concert troupe as a singer. At Brussels by a fortuitous chance she was given the rôle of Carmen to study, mastered it in five days and scored a triumph in the Opera de la Monnaie. This was in 1902 and now she determined to cultivate her voice under the best masters. At Paris she studied for one year under Madame Adiny and the following year began her long series of tours in Europe and America. In 1908–09 she was at the Metropolitan Opera House, New York.

GAY, gī, Nicolay, Russian painter: b. 1831; d. 14 June 1894. He achieved real success with his 'Puschkin' and his 'Peter I,' as Muther says with rather pointed brevity. To us it seems that his other works, or some of them,— so familiar to the public through reproductions,— merit a more attentive study. In religious painting, for example, he appears at first sight to be Ivanov's nearest successor, because of similarities in the aims and problems of the two artists; but A. Benois has shown clearly in 'The Russian School of Painting' (New York 1916) that Gay's whole personality differed essentially from Ivanov's. Gay's highest technical achievement is a certain brilliancy and originality of coloring, but the drawing in his canvases is, with rare exceptions, childish or slovenly; Ivanov, on the contrary, was brought up under the old scholastic discipline and drill of the Academy and showed the results in every stroke of his brush. Again, Gay's themes, marked with the stamp of almost hysterical passion, were diametrically opposed to the holy tranquillity of Ivanov's aspirations. It is only fair to correct a popular misconception and to regard Gay as (despite his faults) a well-pronounced and brilliant artistic personality especially in his last works, which expressed a peculiar and very «Russian» attitude toward the Scriptures. «He views the New Testament,» says Benois, «as the gospel of *spiritual* beauty exclusively, and purposely emphasizes the outward of both Christ and his surroundings. Had Raphael seen 'The Crucifixion' and other of Gay's paintings, monstrous in their ugliness, he would have torn his garments in his indignation. Different would be the relation of Gay to Rembrandt, in whose gloomy art the same notes sound as in Gay's. But Rembrandt was too much of an artist not to conceal the intentional ugliness of his images under the beauty of paintings and coloring. Gay, however, with true Russian straightforwardness, and with truly Russian nihilism, ever in quest of harrowing impressions, strove to depict what appeared to him as truth.» Hence these creations — repugnant, quivering with life, inspiring terror; nevertheless luminously devoid of triviality, wholly individual utterances, white-hot with sincerity and conviction. «The same rare quality distinguishes also Gay's portraits, probably the best Russian portraits of the second half of the 19th century» — the faces almost startlingly life-like, yet bearing also, all of them, the same imprint — that of the painter's own mind. His most impressive portrait, far better than the 'Puschkin,' is his 'Tolstoy,' in the Tretyakov Gallery. In an entirely different class, but also admirable, is his portrait of Mme. Petrunkevich, standing at a window opening on a forest. Another famously good portrait by Gay is his 'Herzen.'

GAY, Sidney Howard, American journalist and author: b. Hingham, Mass., 22 May 1814; d. New Brighton, Staten Island, N. Y., 25 June 1888. Unwilling to take the oath to support the Constitution of the United States, which fostered and protected slavery, he gave up a legal career and devoted himself to anti-slavery journalism and lecturing. He became, in 1842, editor of *The Antislavery Standard*, a position he retained till he joined, in 1857, the editorial staff of the New York *Tribune*, of which he was managing editor 1862-66. From 1867 to 1871 he occupied the same position on the Chicago *Tribune*, and for another two years was managing editor of the *Evening Post*. He was the author of Bryant and Gay's 'Popular History of the United States,' and in 1884 wrote the life of James Madison in the 'American Statesmen' series.

GAY, Walter, American artist: b. Hingham, Mass., 22 Jan. 1856. He is a nephew of S. H. Gay (q.v.), and W. A. Gay (q.v.). At 20 he went to Paris, where he studied art under Bonnat, and he has been a frequent exhibitor at the Salon. He resides in Paris since 1879, and has disposed of more pictures in France than any other foreigner. Among his paintings, which have won many medals, are 'Benedicite,' now in the Museum of Amiens, France, 'Las Cigarreras' ('The Cigarette Sellers') in the Luxembourg, Paris; and 'The Spinners' and other canvases in the Metropolitan Museum of Fine Arts, New York, the Museum of Fine Arts, Boston, and several noted collections in Europe. He is represented also in the museums of Chicago and Pittsburgh, and in the Tate Gallery, London. He was made a Chevalier of the Legion of Honor in 1894, becoming an officer in 1906. His latter work is devoted to rich interiors without figures. The more important of these are 'Interior,' 'Gold and White,' 'The Medallions' in the Luxembourg Gallery; 'Palazzo Barbaro Interior' in the Boston Museum; 'Interior of the Petit Trianon' in the Providence School of Design.

GAY, Winckworth Allan, American artist: b. Hingham, Mass., 18 Aug. 1821; d. 1910. At an early age he became a pupil of Robert Weir, professor of drawing at West Point, subsequently went to Europe, and passed five years there in study, a part of the time under Troyon in Paris. He painted exclusively in landscape. 'A Scene in the White Mountains,' a picture painted for the Boston Athenæum, is a good specimen of his method of treatment of mountain scenery. Some of his best works depict that region. But he also painted views of Nantasket beach and rocks, which have attracted much attention, and some critics have pronounced coast scenery to be his proper specialty. Among his best works are 'Mackerel Fleet off Beverly Coast'; 'Harbor Day at Cape Ann'; 'Forest Sanctuary'; 'Ninieh on the Nile'; 'Windmills of Delfthaven, Holland,' all in the Boston Athenæum; and 'Scene in Japan' in the Somerset Club, Boston.

GAY-LUSSAC, gā-lü-säk, **Joseph Louis,** French physicist: b. Saint Leonard, Haute-Vienne, France, 6 Dec. 1778; d. Paris, 9 May 1850. In 1804 he was the first to make balloon ascensions for purposes of scientific investigation. He became a member of the Society of Arcueil, and was introduced to Humboldt, with whom he prosecuted an investigation of the polarization of light and other subjects. He also devoted much of his time to the study of chemistry, and to him we are indebted for the discovery of the hydro-sulphuric and oxy-chloride acids. In 1830 he became a member of the Chamber of Deputies, and in 1839 was created a peer of France. He enjoyed several official appointments, and was professor of chemistry at the Jardin du Roi.

GAY HEAD, a promontory and lighthouse on the western extremity of Martha's Vineyard, Mass. Lat. 41° 21′ N., long. 70° 50′ W. See MARTHA'S VINEYARD.

GAY SABER, name of a committee of seven troubadours who in 1324 convened at Toulouse with the object of restoring Provençal language and customs.

GAY SCOFFER OF SEVILLE, The. See EL BURLADOR DE SEVILLE.

GAYA, gī'ä, India, chief town of a district of the same name in Bengal, on the Phalgu, a tributary of the Ganges, 57 miles south of Patna. It is a place of the greatest sanctity, from its associations with the founder of Buddhism, and is annually visited by about 100,000 Hindu pilgrims, who pray for the souls of their ancestors at the 45 sacred shrines within and without the walls. The most imposing of the shrines is the temple of Vishnu, which is crowned by a pyramid 100 feet in height. In the Gava proper the Brahmans reside; adjoining is Sahibganj, the trading and official quarter. They are manufacturers of oil, metal work, baskets, rope, mats and twine. It contains also a hospital and a high school. Six miles south is the village of Buddha-Gaya, the home of Buddha. (See BUDDHISM). Pop. about 2,225,000 for the district; city, 49,921.

GAYAL, gī'al, or **MITHAN,** a tame ox (*Bos frontalis*) of northwestern India and the hilly regions of Indo-China, known principally in the herds of the semi-civilized hill-tribes, but which also exists wild in Tenasserim. These cattle are kept for the sake of their beef, gayals never being put to any sort of work, as are humped cattle. This ox is somewhat smaller than the gaur (q.v.), has proportionately shorter legs, rounder and shorter horns, a flatter forehead and greater dewlap. It will interbreed with the gaur and various other bovine species.

GAYANGOS Y ARCE, gī-än'gōs ē är'thā, **Pascual de,** Spanish Orientalist: b. Seville, 21 June 1809; d. London, 4 Oct. 1897. In 1822 he was sent to be educated at Pont-le-Voy, near Blois, and six years later entered on the study of Arabic under Silvestre de Sacy. He made a visit to England and on his return was employed in the treasury at Madrid and in 1833 was made translator to the Foreign Office. He revisited England in 1836, wrote for several English journals and published a translation of Almakkari, 'History of the Mohammedan Dynasties in Spain.' In 1843 he was appointed professor of Arabic at the University of Madrid, which post he held until 1881, when he became director of public instruction. He resigned after a few years; was elected senator for Huelva, and spent his latter years in cataloguing the Spanish manuscripts in the British Museum.

GAYARRÉ, gä-ä-rā', **Charles Etienne Arthur,** American lawyer and historian: b. New Orleans, La., 9 Jan. 1805; d. 11 Feb. 1895. He was admitted to the bar in 1829; was several times a member of the Louisiana legislature; deputy State attorney-general (1831); secretary of state of Louisiana (1846–53). Among his works, which deal largely with the history of his native State, are 'History of Louisiana,' in French (1830); 'Louisiana, its History as a French Colony' (1851); 'Philip II of Spain' (1866); 'Fernando de Lemos,' a novel (1872).

GAYLER, Charles, American playwright: b. New York, 1 April 1820; d. Brooklyn, 28 May 1892. He removed to the West, was a law pupil of Abraham Lincoln, was admitted to practice, in 1848 edited the Cincinnati *Evening Dispatch,* and in 1850 became connected with the New York press, to which he contributed for many years. He wrote for English and American production a large number of plays, according to some statements, nearly 400. These include 'The Heir of Glen Avon,' his earliest attempt, produced in 1839; 'Taking the Chances'; 'Olympiana'; 'The American Cousin at Home' (for E. A. Sothern); 'Night and Morning'; 'With the Tide'; 'Brom Bones'; 'The Connie Soogah'; 'Bull Run'; 'Inflation'; 'Lord Tatters, Irish'; and 'Fritz, our Cousin German,' his most successful work, written for J. K. Emmet and first produced at Buffalo, N. Y., in 1869.

GAYLEY, Charles Mills, American educator: b. Shanghai, China, 22 Feb. 1858. He was graduated at the University of Michigan in 1878, studied at Giessen and Halle, Germany, in 1886–87. From 1880 to 1886 he taught Latin at the University of Michigan, and English from 1887–89, and became professor of the English language and literature in the University of California in 1889. He has chosen as his special field the history and criticism of the English drama, of which his works are considered authoritative. His publications include 'Songs of the Yellow and Blue' (1889); 'Guide to Literature of Æsthetics' (1890); 'English in Secondary Schools' (1894); 'Classic Myths in English Literature' (1893); 'Methods and Materials of Literary Criticism,' with F. N. Scott (1899); 'Representative English Comedies' (5 vols., 1903–13); 'The Star of Bethlehem' (1904); 'Songs of California' (edited 1905); 'Plays of Our Forefathers' (1907); 'Idols of Education' (1910); 'English Poetry: Its Principles and Progress,' with C. C. Young (1911); 'Beaumont the Dramatist' (1913).

GAYLEY, James, American manufacturer: b. Lock Haven, Pa., 11 Oct. 1855. He was graduated in engineering at Lafayette College in 1876, and in 1877–80 was chemist for the Crane Iron Works at Catasauqua, Pa.; in 1880–82 for the Missouri Furnace Company. He was superintendent of blast furnaces of the Edgar Thomson Steel Works, was subsequently promoted to manager of the Edgar Thomson plant and later was managing director of the Carnegie Steel Company until 1901. From 1901 to 1909 he was first vice-president of the United States Steel Corporation, with charge of ore mining, shipping and transportation. His inventions include a bronze cooling-plate for blast furnace walls and an auxiliary casting-stand for Bessemer steel plates. He received the Elliott Cresson medal of the Franklin Institute, Philadelphia, for invention of the dry-air blast. He is president of the Sheffield Iron Corporation, the American Ore Reclamation Company, a trustee of Lafayette College and ex-president of the board of directors of the American Institute of Mining Engineers.

GAYNOR, William Jay, American jurist and public official: b. Whitestown, Oneida County, N. Y., 23 Feb. 1848; d. at sea, 10 Sept. 1913. He was educated at the Whitestown Academy and Assumption Academy, and studied theology for about three years at Saint Louis, Mo. He traveled for sometime, taught school in Boston, removed to Brooklyn in 1873, where he was for a time a journalist. He studied law also at this time and was admitted to practice in 1875, removed to the town of Flatbush, and gained considerable fame as a political reformer, helping elect a reform administration, and becoming police commissioner himself. In 1885 he removed to the city of Brooklyn, and continued his reform work, successfully exposed several corrupt politicians and frauds, was elected to the Supreme Court of New York in 1893. For frauds committed at this election he secured the conviction of John Y. McKane and several of his political henchmen. He was reelected judge in 1907, and in 1909 was elected mayor of New York by a large plurality, being the only candidate on the Democratic ticket to secure election. He at once set about putting the city administration on an efficient basis, and thereby lost the support of Tammany Hall. On 9 Aug. 1910 he was shot by a discharged city employee just as he was going aboard a steamer for Europe. He never fully recovered from the effects of the wound, although he resumed his official duties. In the autumn of 1913 he was a candidate for re-election, this time on an independent ticket, having by his efficient business methods and incorruptibility incurred the displeasure of his former supporters, the politicians of Tammany. His letters brought him considerable fame and were remarkable for their caustic wit and their exposure of fraud and sham in any guise, and were a constant joy to the newspapers and the public. He died before election, while on a voyage to Europe. Consult the volume 'Some of Mayor Gaynor's Letters and Speeches' (New York 1913).

GAZA, gä'zä, Theodorus, Greek scholar: b. Thessalonica, Macedonia, about 1400; d. Italy 1478. He fled about 1444 before the Turks to Italy, where he became teacher of Greek at Ferrara, next of philosophy at Rome. Gaza has been warmly praised by subsequent scholars, such as Politian, Erasmus, Scaliger and Melanchthon. His principal work was a Greek grammar in four books, first published by Aldus Manutius at Venice in 1495. He translated into Latin portions of Aristotle, Theophrastus, Saint Chrysostom, Hippocrates and other Greek writers.

GAZA, gä'zą, Syria, an ancient town, capital of the district of the same name, about three miles from the mouth of the river Gaza, 50 miles from Jerusalem, on the high road between Egypt and Damascus. The bazaar and markets are of considerable importance. Gaza is a depot for barley and has many potteries. The district of Gaza occupies the southwest corner of Syria, having the Mediterranean on the west, the valley of the Jordan and of the Dead Sea on the east and Arabia Petræa on the south. It was a city of importance 1,000 years before the Christian era and figures frequently in the history of Babylon, Egypt, the Pilisti and the Persians. It was taken by Alexander after a short siege. In Roman times it was known as Constantia and regained much of its former prominence. It became a centre of Hellenic culture and rivaled Antioch, Alexandria and Athens in this respect. Proclus, Olympianus and Isidor were among its most celebrated teachers. Christianity found learned defenders amongst its citizens, notably Procopius, Choricius, and Joannes. The city was taken by Omar in 634, and it fell into decay. It was in ruins the time of the Crusades. A citadel was built by Baldwin II in 1149; Saladin sacked it in 1170 and captured the citadel from the Templars in 1187. Napoleon took the city in 1799. On 7 Nov. 1917 it was taken by the British in their advance on Palestine. See WAR IN EUROPE: *Turkish Campaign*, and consult Clermont-Ganneau, 'Archæological Researches in Palestine' (London 1896); Gatt, «Gaza» in *Zeitschrift des deutschen Palästina Vereins*, Vol. I (1888); Meyer, M. A., 'A History of Gaza' (New York 1907); Schürer, 'Geschichte des jüdischen Volkes' (4th ed., Leipzig 1907); Smith, 'Historical Geography of the Holy Land' (London 1895); Stark, 'Gaza und die philistäische Kuste' (Jena 1852).

GAZALAND, gä'zą-lănd, Portuguese East Africa, a district extending north from the Manhissa River, Delagoa Bay, to the Pungwe River. It is a well-watered and fertile region. About 1832 the Portuguese secured a footing in this territory, but it was not until 1895 that all opposition to Portuguese rule ceased. In fauna, flora and commerce Gazaland resembles the adjoining regions of Portuguese East Africa (q.v.). Consult Maugham, R. C., 'Portuguese East Africa' (London 1906), and Theal, G. McCall, 'History of South Africa since 1795' (Vol. V, ib. 1908).

GAZELLE, a small antelope of the genus *Gazella*, or some related genus, exemplified by the «ariel» or «dorcas» of the Saharan and Syrian deserts, famous in poetic literature. The group contains some 25 species scattered throughout all Africa and southern Asia; and as a whole is characterized by small or moderate size, a sheep-like dentition, sandy coloration with white belly, and the usual presence of dark and light stripes on the face and flanks. The horns are of fair length, ringed, lyrate and usually present in both sexes. The gazelle (*G. dorcas*), stands about 24 inches tall at the shoulders, and has horns about 13 inches long. It is of delicate build, and extreme swiftness, leaping high as it runs, so that at full speed it seems to skim the ground like a flying bird. Its color is a light fawn upon the back, deepening into dark-brown in a wide band which edges the flanks and separates the yellow-brown of the upper portions of the body from the pure white of the abdomen. The face is marked with two stripes of contrasting colors, and the ing comparison to that of a woman. Gazelles is large, soft and lustrous, and has been long employed by Eastern poets as the most flattering comparison to that of a woman. Gazelles feed generally at dawn and at evening, and approach water only once in 24 hours. They are hunted in various ways, and their flesh is excellent. This species is becoming rare, but may still be found throughout the Sahara, and in the stony deserts of Syria. Many local names have been applied to it in books of travel and reference, most of which belong elsewhere. Such are the «korin» or «corinne» of Senegal (*G. rufifrons*); the West African «mohr» (*G. mohr*), the largest (32 inches high) and tallest of the race; the «aoul» (*G. sœmmerringi*) of Abyssinia and Somaliland, the «dama» (*G. dama*) of the Sudan, and others formerly confused with *G. dorcas*. Still other species range the plains of Central and South Africa, where some, as the springbok (q.v.), formerly assembled in vast herds, as described under ANTELOPE. Another group is formed by three similar Asiatic gazelles,— one common in Persia (*G. gutturosa*), and the others eastward, where the «goa» dwells on the high Tibetan plateau. Lastly in the Indian gazelle (*G. bennetti*), the «ravine-deer» of Indian sportsmen, we have a species with almost straight horns, which is about 26 inches tall, light chestnut in color with a blackish tail, and dwells in small bands in the dry plains along both sides of the Indus.

GAZETTE. *Gazetta* was the name of a small coin once in use at Venice, and also of a kind of primitive newspaper, published by the government there in 1566 and sold for that sum. *Gazzetta*, Spanish *Gazeta*, French *Gazette*, are still used for a newspaper, but the term in England is confined to that paper of news published by authority of the government. The first *Gazette* in England was published at Oxford, 7 Nov. 1665. From that period the *Gazette* has appeared regularly twice a week, and besides the notifications published by court and government contains those required by law in private transactions. Similar gazettes are published in Dublin and in Edinburgh. See NEWSPAPERS.

GAZETTEER, a geographical dictionary. The first work of this kind with which we are acquainted is that of Stephen of Byzantium, who lived in the beginning of the 6th century. We have only an abridgment of it. The first modern work of the kind is the 'Dictionarium Historico-Geographicum' (Geneva 1565), by Charles Stephens, with additions by N. Lloyd (Oxford 1670, and London 1686). The works of Ferrari ('Lexicon Geographicum,' 1627) and Baudrand ('Geographia Ordine Literarum Disposita,' 1682) are full of the strangest errors. Those of Maty (1701), Thomas Corneille (1708), and Savonarola (1713) were based on the former, with additions and corrections. The 'Dictionnaire Géographique, Historique et Critique,' of La Martinière (1726), superseded all that had gone before it, though it retained many errors. The 'Geographisch-Statistisches Handwörterbuch' of the eminent German geographer Hassel (1817) was the result of laborious and judicious investigations. The 'Universal Gazetteer,' by Cruttwell (London 1808) and the 'Edinburgh Gazetteer' (1817–22), once the principal works of the kind in English, were in course of years superseded by several others, among them Macculloch's 'Geographical Dictionary,' Blackie's 'Imperial Gazetteer' (Glasgow 1850), Lippincott's 'Pronouncing Gazetteer of the World' (Philadelphia 1855, completely rewritten with new editions and revisions 1911), and Longmans' 'Gazetteer of the World' (London 1906). The most valuable among European gazetteers further include the French 'Dictionnaire Géographique Universel,' Saint-Martin's 'Nouveau Dictionnaire de Géographie Universelle' (Paris 1879–1900), and Ritter's 'Geographisch-Statistisches Lexikon' (Leipzig 1874; 9th ed., 1905 et seq.); also Garollo's 'Dizionario geographico universale' (Milan 1898), notably accurate. There are also gazetteers confined to individual States of the Union, and others to particular countries of the world. Among the latter is the elaborate 'Gazetteer of India' by Hunter (London 1886–88).

GAZOGENE, an apparatus for the generation of carbon dioxide used in the manufacture of carbonated waters; also a generator of illuminating gas after the du Motay process.

GEANTICLINE. See FOLDS.

GEAR LOCOMOTIVES. See LOCOMOTIVE.

GEAR WHEELS, toothed wheels for the transmission of motion or power, or both, from one part of a machine to another. They are of several forms, including spur gears with teeth parallel to the axis of the wheel, worm wheels, bevel wheels, etc. These forms are familiar to most people to-day, being found in watches, automobiles, sewing machines, printing presses, etc. Consult Beale, 'Practical Treatise on Gearing' (10th ed., Providence 1911).

GEARING. See GEARS.

GEARS, the moving parts of a mechanism for the transmission of motion. The commoner gears may be grouped into six classes: (1) spur gears; (2) bevel gears; (3) worm gearing; (4) spiral gear; (5) helical gear; and (6) chain gearing.

Spur gears are toothed wheels in which the teeth are parallel with the axis. This is the commonest gear in use, and is employed to transmit motion between lines of shafting which are parallel. *Bevel gears* are toothed wheels in which the teeth are formed on the beveled surface of cone frusta: they are used to transmit motion to shafting which intersects at right angles. *Worm gearing* is a combination of a screw and a toothed wheel: it is used in the transmission of motion where shafting crosses at right angles, but not in the same plane. *Spiral gears* are formed of wheels which are practically sections of screws of very steep pitch: they are used to transmit motion between shafting crossing at acute angles, and not in the same plane. *Helical gears* are composed of toothed wheels and pinions in which the teeth or cogs are cut on the lines of a spiral angle of 23 degrees. They are seldom used in the single form on account of the axial thrust developed, but they are cut in herring-bone fashion, right hand on one face of the wheel and left hand on the other, forming a tooth shaped liked a broad V. This cutting is known as double helical gearing. It is regarded as the most perfect of all gears, transmitting in some instalments 98 per cent of the power. Great speed is obtained, as a pinion may have as few as seven teeth to 140 in the wheel. Moreover, in operation the gear is nearly noiseless. Where reversing the motion is necessary, triple helical gearing is used, the teeth being cut in three trends. Beveled helical gears are also in use, in both the single and double types. *Chain gearing* makes use of two spur wheels with peculiarly shaped teeth, on shafts at a considerable distance apart. Motion is transmitted by means of an endless chain having flat open links which engage the teeth of the wheels.

Many forms of gearing have been devised for the transmission of interrupted motion, and for the conversion of continuous motion into special directions. These gears are of most intricate and ingenious character. Illustrations and descriptions of some of the more important may be found in 'Mechanical Appliances; Mechanical Movements; and Novelties of Construction' (New York 1914), by G. D. Hiscox. See WHEEL GEARING. Consult Flanders, R. E., 'Gear Cutting Machinery' (New York 1909); Ingham, A. E., 'Gearing' (London 1914).

GEARY, John White, American military officer and politician: b. Mount Pleasant, Westmoreland County, Pa., 30 Dec. 1819; d. Harrisburg, Pa., 8 Feb. 1873. He was a lieutenant-colonel in the Mexican War; went to California and was appointed postmaster at San Francisco in 1849, being the first to hold that position in the city. In 1850 he was elected the first mayor of San Francisco, and in 1856 was made territorial governor of Kansas. When the Civil War broke out he enlisted in the Union army and became brigadier-general of volunteers 25

April 1862. He was in the battle of Cedar Mountain 9 Aug. 1862, and commanded a division at Chancellorsville, Gettysburg and Lookout Mountain. He also participated in Sherman's march to the sea. He was governor of Pennsylvania from 1867 till shortly before his death.

GEBA, zhä'ba, a river of western Africa, flowing in a southwesterly course through Portuguese Guinea. It enters the Atlantic by a wide estuary and close to the town of Geba.

GEBAL, ge'bal, the name of two places in Palestine, the name signifying mountain. The first is a mountainous district south of the Dead Sea in the land of Edom. It is undoubtedly referred to in Psalm lxxxiii, 8. The second is a city and district located near Mount Lebanon on the shores of the Mediterranean. It was included in the original Promised Land but was not occupied by the Israelites at any time. The city was about 20 miles north of the present city of Beirut. It was known to the Greeks as Byblus. Its name appears often in Phœnician and Assyrian inscriptions and on the Tell El-Amarna tablets. Pliny calls it Gebale. It was famous in the ancient world as the birthplace of Adonis, the Syrian Tammuz and his worship. In the time of the writer of 2 Kings v, 18, the inhabitants were evidently skilled stone-workers if the accepted text of the passage is correct. Ezekiel xxvii, 9, speaks of the «wise men of Gebal» as being experienced ship calkers, or carpenters of the ships of Tyre. According to Strabo their work was much interfered with by robbers which infested the Lebanon range. Pompey not only destroyed the robber nests, but delivered the city from a tyrant. Later the city was an episcopal see in the patriarchate of Antioch subject to the metropolitan of Tyre. Quite recently it continued to furnish the title for an episcopal see. It is now largely in ruins and has only a small population. It is called Jebail by the Arabs.

GEBAUER, gä'bow-ĕr, **Jan**, Czech philologist: b. Ubislavicz, Bohemia, 1838; d. 1907. He received his education at the University of Prague and became instructor in literature there and in 1874 was appointed to the chair of Slavic philology. He made many translations from Bulgarian, Russian and Sanskrit. He is best known, however, for his philological researches in old Czech literature. He wrote 'Zaltar Wittenbersky' (1880); 'Historical Czechic Grammar' (1898); 'Old Czech Dictionary' (1903). He was a member of the editorial staff of the *Listy Filologické* after 1874.

GEBER, the supposed name of an Arab scholar and author, of whom nothing is known beyond his works, about 26 in number, which repose in various continental libraries. Latin translations have been made of some, such as 'Geberi Philosophi de Alchimia Libri Tres' (1531); 'Geberi Arabis Chimia sine Traditio Summæ Perfectionis et Investigatio Magisterri' (1668, English translation by Russell 1678). Consult Berthelot 'La chimie au moyen âge' (Vol. III, Paris 1893) and Wüstenfeld, 'Geschichte der arabischen Aerzte' (Göttingen 1840).

GEBERT, gā'bĕrt, **Johannes Sophus**, American sculptor: b. Schleswig, Denmark, 10 Dec. 1852. Worked as a wood carver from 1867–72, graduated with honors from the Royal Academy of Fine Arts, Copenhagen, 1875. Worked in Paris 1877–78, exhibited at the Salon 1878 a colossal group, 'The Norse God Thor wrenching the head of a bull.' Worked for Prof. R. Simering in Berlin 1879–82. He received a scholarship from the Danish government which enabled him to study in Rome 1882–83. Returning to Copenhagen he executed architectural statuary and ornaments for buildings in Denmark and Sweden. He emigrated to America in 1887 and became a citizen in 1892. He was established as a sculptor in Chicago until 1898, since then in New York. He has executed the following public monuments: Hay Market Monument, Hans Christian Andersen and Beethoven, Chicago; decorated the Chicago *Herald* building with historical statuary, likewise the Auditorium and McWicker's Theatre; executed a monument, portrait statue of General Grant, with bas-relief representing Lee's surrender at Appomattox; Furman statue in Vanderbilt University, Nashville; also a cemetery monument to Furman in Nashville; statue of Napoleon for the Missouri State building, Saint Louis, now in Art Museum there; also a statue of Gothic Art for the porticos of the Art Museum of Saint Louis and a statue of General Stevens, the founder of the city of Minneapolis. He executed four statues for the Aptrop Apartment building, 'The Four Seasons'; four statues representing Roman civilization for the Brooklyn Institute of Science and Art. Decorated the Bergen County courthouse with nine statues and a historical frieze. He has executed numerous portrait busts and bas-reliefs all over the country; was a member of the International Jury of Awards, Chicago Fair, 1893; was awarded three gold medals — two in Philadelphia for ideal works: a group of children called 'The Little Architect' and a statue of 'Theseus courting Andromeda.' At the Nashville Centennial Exposition he was awarded a gold medal for the 'Wounded American Soldier.' In the United States Custom House, New York, there is, among other statues representing 12 seafaring nations, a statue of Denmark executed by him. He has executed numerous ideal statuary, for instance two dancing Bacchantes (Berlin) 1881. One of his latest, a family group representing 'Evening Prayer' (1913), was exhibited at the San Francisco Fair 1915.

GEBHARD, gāb'härt, **Heinrich**, American pianist: b. Sobernheim, Rhine Province, Germany, 25 July 1878. In 1889 he settled in Boston; studied pianoforte, theory and composition under Clayton Johns of that city and under Leschetizky at Vienna in 1895–99. In 1900 he returned to Boston and in the same year made his professional début with the Boston Symphony Orchestra. He has appeared in the principal cities of the United States with the Kneisel Quartet and in recitals of his own, and with other orchestras.

GEBHARDT, Eduard von, German painter: b. Saint Johannes, Esthonia, 13 June 1838. He studied at the Petrograd Academy in 1854–57, and later with Wilhelm Sohn at Düsseldorf, where he established his studio and attracted much attention by his religious works, in which he treated biblical scenes after the manner of the Dutch and Germans of the 15th and 16th centuries, imitating their introduction of costumes and other features contemporary to them. He also painted many scenes from the period of the Reformation. In 1873 he was appointed professor in the Düsseldorf Academy. His subjects include 'Christ's Entry into Jerusalem'; 'The Rich Man and the Beggar Lazarus'; 'The Last Supper,' his chief work (National Gallery, Berlin); 'The Ascension,' one of his best canvases; 'Religious Conversation'; and 'The Reformer at Work' (1877 Leipzig Museum). Other important canvases are 'The Crucifixion' (1873), in the Hamburg Gallery; 'Taking Care of Christ's Body' (1883) and 'Jacob and the Angel' (1893), both in the Dresden Museum; 'Christ and the Rich Youth' (1892) and 'The Sermon on the Mount' (1893), both in the Düsseldorf Gallery; 'Healing of the Palsied' (1895), in the Breslau Gallery; 'Christ upon the Waters' (1902), in the Düsseldorf Gallery. There is also a series of six mural paintings by him dealing with scenes in the life of Christ, painted in the old monastery of Lokkum. This series shows some Pre-Raphaelite tendencies. There are also fine mural paintings by him in the Friedenskirche, Düsseldorf. He is a member of several national academies and has received numerous awards. Consult lives by Rosenberg (Leipzig 1899) and Schaarschmidt (Munich 1899).

GEBHART, Emile, French author: b. Nancy, 1839; d. 1908. He received his education at the Lycée of Nancy and at the French School at Athens. He was appointed professor of foreign literatures at Nancy in 1860 and 19 years later removed to Paris as professor of Romance literatures. He was chosen member of the Academy in 1904. He published 'Les historiens florentins de la Renaissance' (1875); 'Rabelais, la renaissance et la réformé' (1876); 'Les origines de la Renaissance en Italie' (1879); 'L'Italie mystique' (1890); 'Moines et papes' (1896; 4th ed., 1907); 'Au son des cloches' (1898); 'D'Ulysse à Panurge' (1902); 'Jules II' (1904); 'Florence' (1906); 'Sandro Botticelli' (1907).

GEBWEILER, gāb'vī-lĕr, Alsace, town situated at the foot of the Vosges, on the Lauch, 14 miles south of Colmar. The principal buildings are Saint Leodgar's Church, dating from the 12th century, the Evangelical church, the synagogue, the town hall and the old Dominican convent now converted to secular uses. The principal industries are dyeing and spinning, cloth weaving, machine-making, soap, sugar and brick manufacturing, and white wines. The town is mentioned first in 774; for a long time it was part of the foundation of Murbach and in 1759 became the residence of the abbots. The Revolution brought destruction to the monastic establishment and the great library there was lost. Roman Catholicism is the prevailing religious faith. Consult Dietwiler, 'Gebweiler Chronik' (Gebweiler 1898). Pop. 13,100.

GECKOS, gek'ōz, the small lizards of the family *Geckonidæ*, distinguished from other lizards by structural peculiarities which indicate that the group is a very ancient and distinct one. Externally their robust forms, short heads and thick, but fragile tails: the skin in most soft and pebbled with minute bony concretions (osteoderms); the lack of eyelids, the ball of the eye being studded by a transparent watch-glass-like scale; and adhesive feet are so highly characteristic that a gecko is usually recognizable at a glance. The group consists of about 50 genera, comprising some 270 species, and they are scattered all over the warmer part of the globe, occurring even in New Zealand and many oceanic islands. Most of the species are small, the largest not much exceeding a foot. They dwell mainly in the woods, and among rocks, hiding by day, or basking quietly in the sun, and becoming active at night. They are carnivorous, the smaller eating insects and the larger bigger insects and whatever else they can catch. They are well fitted for scrambling about tree trunks and cliffs, as is seen in the agility of the common "tarentola," "osga" and other geckos of southern Europe, and the almost domestic "cheecha" (*Hemidactylus*) of Ceylon and India, which are numerous both outside and inside of farm and village houses, snapping up flies. They will climb a smooth wall or even a window pane without difficulty, and even run back downward along the smooth whitewashed ceiling. This is possible for them by the fact that the soles of the cushions of the toes are furnished with transverse lamellæ beset with tiny hair-like excrescences, between each two of which a vacuum is formed by the pressure of the foot on every step. Upon the differences in the arrangement of the pads and lamellæ are based generic distinctions. In addition to this facility of movement, one species (*Ptychozoön homalocephalum*), the flying or fringed gecko of the Malayan region, has a lateral parachute-like membrane assisting it to make long leaps from tree to tree.

Geckos are entirely harmless and could not inflict a painful bite if they tried; yet the peasants of Spain and Italy fear as poisonous even those which they see daily in their houses, and the Egyptians accuse them of leprosy. When encouraged they become tame and friendly and show considerable intelligence. Their voices produce a feeble clicking sound, often repeated, from which comes the term "Gecko" and such local names as "toco-toco" and the like. They reproduce by hiding among rotten wood two or three globular hard-shelled eggs, from which the young hatch, and are ready at once to begin to care for themselves. Consult Gadow, 'Amphibia and Reptiles' (1901); Gosse, 'A Naturalist's Sojourn in Jamaica' (London 1851).

GED, William, Scottish goldsmith, inventor of stereotyping: b. Edinburgh, 1690; d. there, 19 Oct. 1749. In 1725 he took out a patent for his method of stereotyping, which was for long the only one in use. He met with such opposition in Edinburgh that he went to London, but there also failed to get his invention adopted. In 1731 he obtained a contract to print Bibles and prayer-books for the University of Cambridge, but only two prayer-books had been executed when the lease was surrendered. He stereotyped an edition of Sallust in 1744. Consult 'Memoir,' by Nichols (1781).

GEDALIAH is the name of no less than five individuals mentioned in the Old Testament. The most important was the son of Ahikam, and grandson of Shaphan, the secretary of King Josiah (2 Kings xxii); Gedaliah was appointed by Nebuchadnezzar as governor over "the poor of the people that were left in the land." He ruled only two months and was treacherously assassinated. He set up his government in Mizpah. Jeremiah the prophet, and many dispersed Jews and the remnants of the army gathered about him. This was not to the liking of Baalis, king of the Ammonites, who plotted to destroy "the remnant of Judah" and its governor. A bandit in his service, Ishmael of the royal line of Judah, who had been a high officer under King Zedekiah, was a traitorous tool ready for his purposes. With 10 of his men Ishmael sought Gedaliah, and though warnings were not lacking, was cordially entertained by him. The plot was successful. Gedaliah and his little group of followers were slain, it is thought, while they were dining. Their bodies were cast into the cistern of Asa (Jer. xli, 9). Fearing the displeasure of the Babylonian authorities, the remnant fled to Egypt, compelling Jeremiah to accompany them (Jer. xii, 2, 18). The assassination occurred on the third day of the month of Tisri, which has ever since been observed as one of the four fast days among the Jews. By the assassination of Gedaliah and the dispersion of his followers, the final utter ruin of Judea was accomplished.

GEDANUM. See DANZIG.

GEDDES, ged'es, **Alexander,** Scotch Roman Catholic clergyman: b. near Ruthven in Banffshire, 14 Sept. 1737; d. London, 26 Feb. 1802. He studied eight years at the Roman Catholic Seminary at Scalan and seven at the Scotch College in Paris. On his return to Scotland in 1764, he served as a priest not far from Angus. In 1765 he became chaplain to the Earl of Traquair. In 1769 he become priest of the parish of Auchinhalrig. Ten years later he attended a Presbyterian meeting without the consent of his superior and was then deprived of his charge. In 1780 he settled in London, devoting the rest of his life to study and literary work. Lord Petre allowed him a pension of £200 per year so that he might continue his great work of translating the scriptures. He published two volumes (1792–97) containing the Pentateuch and the historical books. At the time of his death he was at work on the Psalms, which was finished by another hand and published in 1807. He also issued 'Critical Remarks on the Hebrew Scriptures, corresponding with a new translation of the Bible Vol. I, containing remarks on the Pentateuch' (1800). He was the author of several volumes of poems, including a translation of the first book of Homer's 'Iliad' (1792). He also wrote several replies to the various criticisms of his translations and also 'A Modest Apology for the Roman Catholics of Great Britain' (Anonymous 1800). Consult Good, John Mason, 'Memoirs of the life and writings of Alexander Geddes' (London 1803), also Cheyne, T. K., 'Founders of Old Testament Criticism' (New York 1893, pp. 4–11).

GEDDES, Andrew, Scottish painter: b. Edinburgh, 1783; d. London, 1844. He studied at the university in his native city and held a post in the excise office for five years. After his father's death, he entered the Royal Academy art schools at London in 1831, and in the following year was elected associate of that institution. He painted portraits chiefly, but exhibited also a few genre and historical subjects, chiefly 'The Ascension,' now at the church of Saint James, Garlick Hill, London; the 'Discovery of the Scottish Regalia' (1821). His best-known portraits are those of Wilkie (1816); his mother; Miss Nasmyth as 'Summer'; 'Dull Reading,' a portrait study of Daniel Terry and his wife,— all in the National Gallery of Scotland,— and an admirable portrait of Sir Walter Scott, in the Scottish National Portrait Gallery. He executed also some excellent copies of the old masters and several fine etchings. Geddes' distinguishing characteristics are his feeling for personality, and his discriminating use of color. Consult McKay, W. D., 'The Scottish School of Painting' (1906).

GEDDES, Sir **Eric Campbell,** British statesman and administrator: b. Agra, India, 1875. Intended for the army, young Geddes was sent to Scotland and educated at Merchiston Castle School, Edinburgh. He later passed the preliminary examinations at the Oxford Military College at the age of 17, but did not pursue the course. Working his passage to America, he found employment in the Carnegie steel works at Homestead, Pa. Afterward he drifted to Nicolette, near Parkersburg, W. Va., and worked for a time in a lumber camp. He was then 20 years old. A young woman telegraph operator at a nearby station taught him the Morse code. Geddes' next undertaking was that of a switchman on the Baltimore and Ohio Railroad. He rose to station master at a small place, remained there three years and then returned to England. Before long, however, he set out for Australia, but disembarked at Ceylon and took up sugar planting. After trying this occupation for a short time Geddes went to India and became manager of a large forestry concern. Here he brought his American experience into play by constructing and running a two-foot six-inch light railway through the jungle. His little railroad was eventually amalgamated with a larger line and Geddes became traffic manager of the Rohilkund–Kumaon Railway. He resigned in 1903, returned to England, and entered the service of the Northeastern Railway. From claims agent he rose to deputy general manager, which position he held at the outbreak of the European War in 1914. When the British government took control of all the railroads, Geddes was appointed chairman of the central committee of railway authorities for the mobilization of the Northern District.

In the early part of 1915, when a Ministry of Munitions was instituted, Lloyd-George, first head of the new department, appointed Geddes deputy director-general of munitions supply. Between May and December 1915 he controlled and organized the supply of rifles, machine-guns, small arms, ammunition, optical instruments and glass, transport vehicles and salvage, and also had administrative control of the Royal Ordnance Factories of Woolwich, Waltham and Enfield. At the end of 1915 he had put all departments in working order and delegated their supervision. He retained control of Woolwich Arsenal and was placed in charge of the filling of gun ammunition and the organization of the national filling factories. During the battle of the Somme, when the supply of munitions had become abundant and the filling factories were in full operation, Geddes went to France to report on the transport situation there. He next reorganized the whole transportation services behind the front. This led to his appointment as director-general of military railways at the War Office, exercising supervision over transportation in all theatres of war and also being responsible for obtaining the necessary supplies of material and arranging the personnel for the services. While at the front he was invited by Sir Douglas Haig to join his staff as director-general of transport. By arrangement, the unusual course of having a War Office official on the staff and a commander in the field was agreed to, and Geddes, now Major-General Sir Eric Geddes, undertook both duties. Meanwhile, it was decided to revive the long obsolete office of Controller of the Navy. On 28 March 1917 it was announced that Geddes had been appointed inspector-general of transportation in all theatres of war. On 14 May came the official announcement that Sir Eric Geddes was "to become an additional member of the Board of Admiralty, with the title of Controller and with the honorary and temporary rank of vice-admiral." For the first time in British history the Controller of the Navy was a civilian, who presided at the Navy Board, controlled all naval and mercantile construction and repairs, all harbors and ports, guns, airships and munitions. On 3 June 1917 Geddes was created K.C.B. in the military division. On 18 July 1917, when Sir Edward Carson relinquished his post, Sir Eric Geddes succeeded him as First Lord of the Admiralty. It now became necessary to find him a seat in Parliament. Two days later Mr. Almeric Hugh Paget, Unionist member for Cambridge, resigned his seat in order to provide a seat for the new First Lord. Brigadier-General A. C. Geddes, a younger brother of Sir Eric, was director of recruiting in 1916, and became Minister of National Service in 1917. Before the war he was a professor of anatomy at McGill College, Montreal.

HENRI F. KLEIN,
Editorial Staff of The Americana.

GEDDES, James, American scholar: b. Boston, Mass., 29 July 1858. He was graduated from Harvard in 1880, was instructor in Romance languages at Boston University in 1887–90, assistant professor in 1890–92, and in 1892 was appointed professor. His writings include various monographs and articles for periodicals, and students' editions of Spanish and Italian classics and 'Canadian French, the Language and Literature' (1902); French prose translations of Müller text of old French poem, 'La chanson de Roland' (1906); 'French Pronunciation' (1913). He is a member of the Executive Council of the Modern Language Association of America.

GEDDES, James Lorraine, American soldier: b. Edinburgh, Scotland, 1827; d. 1887. After residence in Canada from 1837 to 1843, he studied in the British military academy of Calcutta, India, entered the British army and distinguished himself in the Punjab. He settled at Vinton, Iowa, in 1857. In the Civil War he served from 1861 to 1865, and attained the brevet rank of brigadier-general of volunteers. Later he held various positions in the Iowa College of Agriculture from 1870, after having been principal of the Vinton College for the Blind. He wrote 'The Stars and Stripes,' 'The Soldier's Battle Prayer' and other war verse.

GEDDES, Patrick, Scottish biologist: b. Perth 1854. He was educated at Perth Academy, the Royal School of Mines, University College, London, the Sorbonne, the universities of Edinburgh, Montpellier, etc. He was successively demonstrator of physiology at University College, London; of zoology at the University of Aberdeen; of botany at Edinburgh; lecturer on natural history in the School of Medicine, Edinburgh, with intervals of travel, explorations in Mexico, visits to Continental universities, zoological stations and botanic gardens, as also to Cyprus and the East, the United States, etc. His educational work dealt mainly with the organization of University Halls, Edinburgh and Chelsea, each as a beginning of collegiate life. He also became interested in a printing establishment dealing with Celtic and general literature and art. He also has been actively employed in city improvement, town-planning and educational initiatives at home, on the Continent and in India. He is professor of botany at University College, Dundee (Saint Andrew's University). His publications comprise numerous articles in the 'Encyclopædia Britannica,' 'Chamber's Encyclopædia,' etc.; 'The Evolution of Sex' (1889); 'Chapters in Modern Botany' (1892); City Development' (1904); 'Cities in Evolution' (1908).

GEDDIE, John, Canadian missionary: b. Banff, Scotland, 1821; d. 1895. He was brought to Nova Scotia in childhood and in 1838 was ordained to the ministry of the Presbyterian Church. In Nova Scotia he planned the missionary movement of his Church and in 1846 was sent as missionary to the Hebrides, the first missionary to labor in those islands. He translated schoolbooks, hymnbooks, general devotional works and the New Testament into the native tongue of the islanders. He published 'Memorial to the Presbyterian Synod of Nova Scotia' (1844); 'The Proposed Mission to New Caledonia' (1846); 'Universal Diffusion of the Everlasting Gospel' (1846), and letters to periodicals of Nova Scotia describing his missionary labors.

GEDEN, Alfred Shenington, English Methodist divine: b. Didsbury, Manchester, 26 Nov. 1857. He was educated at the Manchester Grammar School and at Magdalen College, Oxford. He entered the Wesleyan ministry in 1881, and in 1887–88 was principal of the Royapettah College, Madras. Since 1891 he has been professor of Old Testament languages and literature, and of comparative religion at the Wesleyan Theological College, Richmond, Surrey. He translated Deussen's 'Philosophy of the Upanishads' (1906) and published 'Hebrew Exercises' (1897); 'Studies in Comparative Religion' (1898); 'Studies in Eastern Religions' (1900); 'Outlines of Introduction to the Hebrew Bible' (1909); 'Studies in the Religions of the East' (1913); 'Comparative Religion' (1917); articles in Hastings' 'Encyclopædia of Religion and Ethics'; 'Dictionary of Christ and the Gospels,' etc. He was joint editor of 'Concordance to the Great Testament' (3d ed., 1913).

GEDIMIN, gā'dē'mĭn, or **GEDYMIN**, Grand Duke of Lithuania; d. 1342. He inherited vast regions comprising Lithuania, Red Russia, Minsk, etc., and immediately had to undertake defensive operations against the predatory Teutonic knights. The better to effect his purpose he secured the protection of the Holy See and opened his lands to men of every order and profession, the first to open semi-savage Russia to the influences of western culture. He was soon engaged in war with the Teutonic knights, but succeeded in extending his domains to the south and east. He was a wise ruler; he protected the clergy of all faiths, encouraged them to civilize his subjects, built strong fortresses along his borders, and built several towns, including Vilna, his capital. He was killed at the siege of Wielowa. Consult Narbutt, Teodor, 'History of the Lithuanian Nation' (Vilna 1835).

GEE, gē, **Thomas**, Welsh preacher and journalist: b. Denbigh, 24 Jan. 1815; d. 28 Sept. 1898. In 1829 he entered his father's printing office and in 1837 went to London to attain greater proficiency in his trade of printer. Soon after his return he engaged in literary and religious work, established the magazine *Y Traethodydd* (The Essayist), issued the 'Gwyddoniadur Cymreig' (Welsh Encyclopædia) and Evan's 'English-Welsh Dictionary' (1868). He also founded the *Baner Cymru* (Welsh Banner) which in 1859 was merged with *Yr Amserau* (The Times). This paper was a pillar of strength to the Nationalist movement in Wales and its circulation there was universal. In 1847, Gee was ordained to the Calvinistic Methodist ministry and did much for the promotion of temperance and Sunday-school work. He believed in complete disestablishment and favored an itinerant unpaid ministry rather than the usual settled pastorate.

GEEFS, gāfs, **Gillaume**, Belgian sculptor: b. Antwerp, 10 Sept. 1806; d. Brussels, 24 Jan. 1883. He became professor at the Academy of Antwerp in 1834. Among his most important works are the monument to the victims of the Revolution of 1830 at Brussels, a statue of Rubens in front of Antwerp Cathedral and statue of King Leopold.

GEEFS, Joseph, Belgian sculptor: b. Antwerp, 25 Dec. 1808; d. there, 10 Oct. 1885. He was a brother of Gillaume Geefs (q.v.). In 1841 he was appointed professor of sculpture in the Antwerp Academy, and in 1846 became a member of the Belgian Academy. Among his principal works are a statue of Vesalius, at Brussels, one of Martens, the first Belgian printer, at Aelst, an equestrian statue of Leopold I, at Antwerp, and 'The Fallen Angel,' in the Brussels Palace of Fine Arts.

GEEL, gāl, **Jacob**, Dutch scholar and critic: b. Amsterdam, 12 Nov. 1789; d. Leyden, 11 Nov. 1862. In 1811 he settled at The Hague where for many years he was employed as tutor. In 1823 he was appointed sub-librarian and in 1833 chief librarian and honorary professor at Leyden. He published editions of Theocritus (1820); of the 'Anecdota Hemsterhusiana' (1826); of Ruhnken's 'Scholia in Suetonium' (1828); of the Vatican fragments of Polybius (1829); wrote 'Historia Critica Sophistarum Græcorum' (1823); 'Commentarius de Reliquis Dionis Orationibus' (1840), and Catalogus Codicum Manuscriptorum qui inde ab anno 1741 Bibliothecæ Lugduni Batavovum Accesserunt' (1852). He also translated several German and English works into his native tongue.

GEELONG, gē-lông', Australia, city of Grant County, Victoria, on Corio Bay, 45 miles southwest of Melbourne. The gold discoveries in 1851 added to its prosperity. Limestone, coal, and a kind of marble are found in the neighborhood. It was early noted for its wool trade, the first mill in Victoria being erected here. The industries are the manufacture of woolen cloths and paper, meat preserving, leather, flour, cement, tanning, rope making, fishing, etc. The city is lighted with gas, and has two parks, botanical garden, government buildings, a town hall, hospital, chamber of commerce, mechanics' institute, etc. Corio Bay is a favorite bathing resort. Within the years 1905–10 the city spent $2,000,000 for dock and harbor improvement. Ships of 23-feet draft may now draw up to the docks, which have railroad connections, and a large export and brokerage trade in wool has arisen in consequence. Pop. 13,618; with suburbs about 27,000.

GEELVINK (gāl'vĭnk) **BAY**, an arm of the Pacific in New Guinea. Its entrance, about 155 miles wide, is protected by several islands.

GEERTZ, gārts, **Julius**, German painter: b. Hamburg, 21 April 1837; d. 1902. He was a pupil of Günther and Martin Gensler at Hamburg, of Descoudres at Carlsruhe and of Jordan at Düsseldorf. In 1864 he set out from home to study the old masters and he visited Paris, Brittany and Holland. It was on his return that he set up his studio at Düsseldorf, and established his reputation by his skilful genre scenes, of which the 'Criminal after Condemnation' was the first to win prominent notice. His works, characterized in general by excellence of design and color, fidelity of interpretation and a capital sense of humor, include 'The Fly-catcher'; 'Die Wacht am Rhein'; 'A Prisoner of War'; 'The Village Hero'; 'Alms.' During a visit to the United States he painted portraits of Oswald Ottendorfer, Carl Schurz and other German-Americans.

GEESE, a large group of water-birds allied to the ducks and swans, and forming with them the family *Anatidæ*. It is not possible to separate geese and ducks into two well-defined groups. Generally speaking, however, geese are distinguished by their larger size; short, heavy bill, with reduced lamellæ; longer legs, placed nearer the centre of the body; and the absence of enlargements of the bronchial tubes. They are better walkers than ducks; the sexes are generally alike in plumage, which undergoes only one moult a year; and both parents attend to the young. They are long-lived, cases having been known when they attained the age of 40. Some 30 species of true geese exist, and about a dozen others are usually known by that name. Males are called «ganders,» and young birds «goslings.» The most typical geese are those of the genus *Anser*, represented in

Europe by the gray lag (*A. cinereus*), bean-goose (*A. segetum*) and white-fronted goose (*A. albifrons*). A variety of the last occurs also in North America. The gray-lag goose is the original of the domestic races of geese. In its wild state it ranges over nearly the whole of Europe and northern Asia, and was formerly an abundant breeder on the British Isles.

The best-known wild geese in America are the Canada goose (*Branta canadensis*), the brant (*B. bernicla*) and the snow-goose (*Chen hyperboreus*). The first-named presents several varieties differing mainly in size, the Hutchin's and cackling goose of the West being not larger than big ducks. One form or another occurs all across the continent, breeding mainly north of the United States, migrating southward in the autumn and wintering on the coasts and inland waters, where they are regularly hunted by sportsmen. In early spring the northward flight of these geese in their customary V-shaped rank is heralded as an indication that winter is over. The brent goose or brant is a smaller, darker bird, breeding far northward and occurring along our coasts often in immense numbers during the winter and also on the coasts of Europe, being everywhere a salt-water bird. The black brant of our western coast and the bernicle goose (q.v.) of the north of Europe are allied species. Several species of snow-geese, or laughing geese, are found in America, most plentiful in the interior. Most of them are pure white in the adult state, more or less gray during the first year; but the blue goose (*Chen cœrulescens*) is always bluish gray, with the head white in the adult.

In Patagonia and the adjacent islands are several peculiar geese in which the sexes differ totally in coloration, the males being white and the females brown; some of them are strictly upland birds. The largest known goose is the Chinese swan-goose (*Cygnopsis cygnoides*), which is supposed to be the parent stock of the domestic geese of some Eastern countries. The peculiar Cape Barren goose of Australia (*Cereopsis novæ-hollandiæ*), an upland goose which has lost the power of flight, has the webbing of the toes greatly reduced and the bill very short and rounded. Another curious species is the spur-winged goose of Africa (*Plectropterus rueppelli*) which possesses hornlike weapons on the bend of the wing. This is a beautiful bird bred in captivity by fanciers for ornamental service.

Domestic Geese.— The breeding of geese is followed on a large scale in some countries and was formerly extensively carried on in parts of England, where the flocks were regularly tended by a gooseherd and driven daily to pasture and water. Two broods are sometimes produced in a season, 10 or 11 in a brood, and the young geese are ready for table three months after they leave the shell. Until the invention of the steel pen, goose quills were used for this purpose. Geese are valuable not only for their flesh and eggs, but for the plumage and where kept for the latter purpose are plucked four or five times a year. The feathers are used chiefly for stuffing pillows, etc.; but as a result of public sentiment against the use of the plumage of wild birds in millinery, the manufacture of artificial plumes and feather-ornaments for hats is becoming an important industry and goose-feathers form the basis of most of these fabrications. Geese are often specially fattened for the table, the flesh of which is 82 per cent edible and 18 per cent refuse. The liver of a fat goose is often larger than all the other viscera. The celebrated *pâtés de foie gras* of Strassburg are made of goose-livers, which are brought to a state of abnormal enlargement by keeping the birds in an apartment with a high temperature and cramming them with food. The oily fat and preserved breasts of geese are German delicacies. Six standard varieties of domestic geese are kept in the United States, for practical purposes, as follows:

Gray Toulouse.— Derived from the neighborhood of Toulouse, France; compact in form; gray, with brown wing-quills, hazel eyes and bills and feet deep orange; full weight, 20 pounds. They are late in maturing and hence are often called Christmas geese; their flesh is not of the best, but they are good egg-layers. They are bred largely by farmers.

White Embden.— Large, tall, snow-white geese derived from Westphalia, weighing 18 to 20 pounds when adult; eyes blue, bills flesh-color; feet deep orange. They are highly regarded by farmers as practical birds.

Gray African.— Tall, with long necks and large heads, a large knob on the base of the bill and a heavy dewlap; general color gray, darkest on the back; eyes hazel; bill black; feet dark orange; weight, 18 to 20 pounds. These are by many raisers considered the most profitable of all geese to keep. They grow the heaviest in the shortest space of time, are ready for market in 10 weeks and as compared with other geese give the most satisfactory returns for the least labor and time spent in growing them. They are first-class layers and their flesh is fine and nicely flavored.

Chinese Geese.— Small graceful geese in two varieties, brown and white, weighing as adult 12 to 14 pounds. In colors and the shape of the head and knobbed bill they resemble the African breed; the white variety is pure white throughout, with the bill orange instead of black. They are the most prolific layers of all the breeds, averaging 50 to 60 eggs a year; and are otherwise commendable, especially for the table.

Wild Geese.— Descendants of the American wild goose; weight 14 to 16 pounds. They are very generally bred throughout the country and exhibit many good qualities.

Consult Weir, 'The Poultry Book' (New York 1903); and Farmers' Bulletin 64, the United States Department of Agriculture.

GEESTEMÜNDE, gā'ste-mọn'de, Germany, seaport town in the province of Hanover, Prussia, at the mouth of the Geeste, opposite Bremerhaven and 32 miles north of Bremen. Its life began in 1857 when the construction of the harbor works was put under way. It has a splendid harbor, safe and commodious and able to care for the largest sea-going craft. It is the most important fishmarket of Germany. The port is protected by great fortifications. There are shipyards, foundries, engineering works, saw-mills, rope works and lumber dressing factories. Pop. 25,000.

GEEZ, gēz, a name applied to the inhabitants of Semitic origin dwelling in Abyssinia and to their language also. The word means "wandering," which evidently refers to the nomadic character of the tribes.

GEEZEH. See Gizeh.

GEFFCKEN, gef'ken, **Friedrich Heinrich,** German diplomatist and jurist: b. Hamburg, 9 Dec. 1830; d. Munich, 1 May 1896. He was educated at the universities of Bonn, Göttingen, and Berlin, and in 1854 became secretary of legation at Paris. From 1856 to 1866 he was diplomatic representative of Hamburg in Berlin and subsequently removed to London in a similar capacity. In 1872 he was appointed professor of constitutional history and public law at the reorganized University of Strassburg. He was made member of the Council of State of Alsace-Lorraine in 1880, but retired after two years and resided thereafter at Munich, where he was suffocated by escaping gas in his bedroom. He was a trusted adviser of Frederick William, afterward Frederick III, and is the supposed author of the German Federal Constitution, which he drew up at Bismarck's suggestion. He also drew up the memorandum which Frederick sent the Chancellor on the occasion of the former's accession in 1888. In October of that year Geffcken published in the *Deutsche Rundschau* extracts from Frederick's diary which gave umbrage to Bismarck and Geffcken was prosecuted for treason but was released after three months. He wrote 'Die Reform der preussischen Verfassung' (1870); 'Der Staatsstreich von 1851 und seine Rückwirkung auf Europa' (1870); 'Die Verpassung des deutschen Bundesstaats' (2d ed., 1870); 'Die Alabamafrage' (1872); 'Das deutsche Reich und die Bankfrage' (2d ed., 1874); 'Staat und Kirche' (1875; Eng. trans., 1877); 'Zur Geschichte des orientalischen Krieges 1853–56' (1881); 'Politische Federzeichnungen' (2d ed., 1888); 'Frankreich, Russland und der Dreibund' (1894); 'The British Empire' (1889).

GEFFCKEN, Johannes, German classical scholar: b. Berlin, 1861. He received his education at Strassburg, Göttingen, and Bonn; was appointed teacher at a Hamburg gymnasium in 1887 and was appointed to a chair at Rostock 20 years later. He has published 'Timaios' Geographie des Westens' (1892); 'Leonidas von Tarent' (1896); 'Oracula Sibyllina' (1902); 'Komposition und Entstehungszeit der Oracula Sibyllina' (1902); 'Aus der Werdezeit des Christentums' (2d ed., 1909); 'Das griechische Drama' (2d ed., 1909); 'Zwei griechischen Apologeten' (1907); 'Die christliche Apokryphen' (1908); 'Kynika' (1909); 'Kaiser Julianus' (1914). He was coeditor of Lubker 'Reallexikon des klassischen Altertums' (1914 edition).

GEFFRARD, zhĕ-frär, **Fabre,** Haitian President: b. L'Anse-à-Beau, 19 Sept. 1806; d. Kingston, Jamaica, 11 Feb. 1879. In 1843 he joined General Hérard's insurrection against President Boyer and as commander of Hérard's advance guard annihilated Boyer's force at Numéro Deux. In the wars with Santo Domingo (1849, 1856) he fought with distinction, later led a successful insurrection against President Soulouque, and was President from 1859–67, when a conspiracy of Salnave, an army officer, obliged him to escape to Jamaica.

GEFLE, yăf'lä, Sweden, a seaport town and capital of Gefleborg, at the mouth of a river of same name in the Gulf of Bothnia. It stands on both sides of the river and two islands formed by it, consists of spacious and well-paved streets and houses partly of wood and partly of stone. It has an old castle, shipbuilding yards and an excellent harbor. Pop. about 32,000.

The district of Gefleborg has an area of 7,614 square miles; a coast deeply indented by bays and an interior partly mountainous and covered with pine forests and containing a large number of lakes, which, with the streams between them, form a kind of continuous network. The rearing of cattle is the chief employment. The most valuable mineral is iron. Pop. about 260,000.

GEFLEBORG. See Gefle.

GEGENBAUR, gä'gĕn-bowr, **Karl,** German anatomist: b. Würzburg, 21 Aug. 1826; d. Heidelberg, 14 June 1903. He was graduated at the University of Würzburg in 1851, having studied under Kölliker and Virchow. After three years of travel in Italy and Sicily he became privatdozent at his alma mater and in 1855 became extraordinary professor of anatomy at the University of Jena and in 1858 he became ordinary professor. In 1873 he was appointed to Heidelberg as professor of anatomy and director of the Anatomical Institute there, where he remained until his retirement in 1901. He was one of the leading comparative anatomists of his time, ranking with Owen and Huxley, and is regarded as the founder of modern anatomy as based on the theory of evolution. He wrote 'Grundzuge der vergleichenden Anatomie' (1870); 'Grundriss der vergleichenden Anatomie' (1878); 'Lehrbuch der Anatomie des Menschen' (1883; 3d ed., 1886); 'Vergleichende Anatomie der Wirbelthiere mit Berücksichtigung der Wirbellosen' (1898). He published an autobiography entitled 'Erlebtes und Erstrebtes' (1901). Consult Fürbringer (in 'Heidelberger Professoren aus dem 19ten Jahrhundert,' Heidelberg 1903).

GEGENSCHEIN, gä'gen-shēn, a spot of light in the heavens diametrically opposite to the position of the sun. It has been observed to be connected with the zodiacal light (q.v.) by faintly luminous bands and is consequently believed by some to be due to the same causes as the zodiacal light proper. It has at any rate been ascertained by means of polariscopic and the spectroscopic investigations that neither the zodiacal light nor the gegenschein is self-luminous and that they both arise from the reflection of solar light by some body or bodies. F. R. Moulton, on the basis of a theory of the zodiacal light which makes it due to the reflection of the solar rays by a swarm of small particles the orbits of which lie just outside of that of the earth, explains the greater luminosity of the gegenschein as due to the retardation of these particles and their consequent banking up by the perturbations induced by the proximity of the earth. Arrhenius, on the other hand, considers that it is formed by a stream of particles repelled from the earth by the sun, after the fashion of the tail of a comet. To be easily visible, the gegenschein must be well above the horizon and is hence best seen in low latitudes. A clear sky is also usually essential, though certain marked anomalies have been observed in this connection. The gegenschein is obscured by the milky way in June, July, December and January and from its extreme faintness is invisible during moonlight or in the neighborhood of a bright star or planet.

GEHENNA, gē-hĕn'a. See HELL.

GEHENNAM, gē-hĕn'am. See TOPHET.

GEHLENITE, gā'lĕn-īt (named by Fuchs after his colleague Gehlen), a grayish-green or brown tetragonal mineral; hardness 5.5 to 6; specific gravity 2.9 to 3.1; lustre resinous or vitreous; fracture uneven to splintery. It is composed of a silicate of calcium and aluminum, $Ca_3Al_2Si_2O_{10}$. This mineral has feeble double refraction. It is found in the Tyrol and in Banat and occasionally occurs among the scoriæ of furnaces.

GEIBEL, gī'bĕl, **Emanuel,** German poet: b. Lübeck, 17 Oct. 1815; d. there, 6 April 1884. He was educated at the University of Berlin; was tutor at Athens for two years; traveled extensively in the Grecian Archipelago with Ernst Curtius. In 1840 he returned to Lübeck and subsequently lived at Stuttgart, Hanover and Berlin. He received a pension from the king of Prussia in 1843 and 10 years later became professor of æsthetics at the University of Munich. He wrote much lyric poetry, the volumes 'Gedichte' (1840); 'Juniuslieder' Gedenkblätter' (1864); 'Spätherblätter' (1877); 'Gedichte aus dem Nachlass' (1896); contributing most to his fame. With Curtius he collaborated in 'Klassische Studien' (1840); with Heyse in 'Volkslieder und Romanzen der Spanier' (1843); and 'Spanisches Liederbuch' (1852); with Leuthold in 'Fünf Bücher französischer Lyrik' (1862). He also wrote the tragedies 'Brunhild' (1858) and 'Sophonisba' (1868) and the comedy, 'Meister Andrea' (1865). His works appeared in eight volumes (3d ed., 1863) and some of his correspondence is contained in 'Briefe an Karl Freiherrn von Malsburg' (1885). Consult Predels, 'E. Geibel und die französische Lyrik' (Münster 1905).

GEIERSTEIN, gī'ĕr-stēn, **Anne of,** a novel by Sir Walter Scott, first published in 1829. Its subject matter is the war between Switzerland and Burgundy in the 15th century.

GEIGER, gī'gĕr, **Abraham,** theologian and critic: b. Frankfort, 24 May 1810; d. Berlin, 23 Oct. 1874. Well equipped with rabbinic and Oriental knowledge, which he proved by his university prize essay on the relations of Judaism and Mohammedanism (originally issued in 1833 and translated into English as 'Judaism and Islam,' Madras 1898), he became rabbi of Wiesbaden in 1832 and in 1835 was one of the most brilliant contributors to the *Zeitschrift für Jüdische Theologie* (1835–39, 1842–47). Called to Breslau 1838–63, he developed into the practical leader of the Jewish reform movement, and wrote many of his scholarly works, in particular his 'Urschrift' (1857), an original contribution to the science of the Bible. In 1863 he became rabbi of Frankfort, and in 1870 was invited to Berlin in a similar capacity, and took charge of the new Jewish seminary. His published works include monographs on Hebrew, Samaritan and Syriac subjects in the magazine of the German Oriental Society; a 'Grammar and Reader of the Language of the Mishna' (1845); 'A Study of Maimonides' (1850); 'Sadducees and Pharisees' (1863); a bold and thoughtful 'Judaism and Its History' (1865–71), besides editing a magazine (1862–74).

GEIGER, Lazarus, German philologist: b. Frankfort-on-Main 1829; d. 1870. He received his education at the universities of Bonn, Heidelberg and Würzburg, and from 1861 to 1870 taught German and Hebrew at the Frankfort Jewish High School. He is the author of the very important philological treatise 'Ursprung und Entwickeling der menschlichen Sprache und Vernunft' (2d ed., 1889; Eng. trans., 1890); and 'Der Ursprung der Sprache' (1869). For biography consult Rosenthal, L., 'Lazarus Geiger' (Stuttgart 1884).

GEIGER, Ludwig, German historian: b. Breslau 1848. He was educated at the universities of Heidelberg, Göttingen and Bonn, and in 1873 was made history dozent at the University of Berlin. Seven years later he became professor of modern literature there. His original studies in humanism have contributed much to the elucidation of that subject. His works include 'Nikolaus Ellenbog, ein Humanist und Theolog des sechzehnten Jahrhunderts' (1870); 'Johann Reuchlin, sein Leben und seine Werke' (1871): 'Petrarcha' (1874); 'Renaissance und Humanismus in Italien und Deutschland' (1882); 'Das Studium der beträischen Sprache in Deutschland vom Ende des 15ten bis zur Mitte des 16ten Jahrhunderts' (1870); 'Geschichte des Juden in Berlin' (1871); 'Vorträge und Versuche' (1890); 'Berlin 1688–1840' (1893–95); 'Das junge Deutschlass und die preussische Zensur' (1900); 'Bettina von Arnim und Friedrich Wilhelm IV' (1902); 'Aus Chamissos Frühzeit' (1905); 'Goethe und Zelters Briefwechsel' (1905); 'Chamissos Leben' (1907); 'Chamissos Werke' (1907); 'Der Briefwechsel Goethes mit Humboldt' (1908); 'Charlotte von Schiller' (1908). In 1886–92 he edited *Zeitschrift für Geschichte der Juden in Deutschland.*

GEIGER, Wilhelm, German Oriental scholar: b. Uuremberg, 1856. He received his education at the University of Erlangen, and in 1891 was appointed to the chairs of Sanskrit and Indo-Germanic philology at the institution. Since 1905 he has been a member of the Landtag of Bavaria. His works include 'Handbuch der Awestasprache' (1879); 'Ostiranische Kultur' (1882); 'Elementarbuch der Sanskrit-Sprache' (2d ed., 1909); 'Ceylon' (1898); 'Litteratur und Sprache der Singhalesen' (1901); 'Dipavamsa und Mahavamsa und die geschichtliche Ueberlieferung in Ceylon' (1905); 'Mahavamsa' (1908–12). From 1885–1905 he was joint editor of *Grundriss der iranischen Philologie.*

GEIJER, gī'ĕr, **Eric Gustaf,** Swedish historian, composer and poet: b. Ransäter, Wermland, 12 Jan. 1783; d. Stockholm, 23 April 1847. Beginning to lecture at Upsala in 1810, he was elected in 1815 assistant professor, and in 1817 professor of history at Upsala. Geijer exercised a marked influence no less on the poetic than on the historical literature of Sweden.

Great as is the value of Geijer's historical works, he unfortunately did not complete any one of the vast undertakings which he planned. Thus, of the 'Svea Rikes Häfder,' or 'Records of Sweden' (1825), which were to have embraced the history of his native country from mythical ages to the present time, he finished only the introductory volume. This, however, is a thoroughly good critical inquiry into the sources of legendary Swedish history. His next great work, 'Svenska Folkets Historia' (1832–36), was not carried beyond the death of Queen Christina. Of his other historical and political works may be mentioned 'The Condition of Sweden from the Death of Charles XII to the Accession of Gustavus III' (1838), and 'Feudalism and Republicanism' (1844). During the last 10 years of his life Geijer took an active part in politics; but, although his political writings possess great merit, the very versatility of his powers diverted him from applying them methodically to the complete elaboration of any one special subject. He was also known to his countrymen as a musician and composer of no mean order and a poet of note. His collected works were published by his son, with a biographical sketch (13 vols., 1849–56). Some of his best poems appeared in *Iduna*, a magazine in which Geijer and his friends were interested. As a musician he set many of his own songs to music which caught the public fancy and were very popular. He was also a writer of excellent hymns. Consult Carlson, 'Biography of Eric Gustaf Geijer' (1870); Malmstroem, 'Life of Geijer' (1848); Nieksen, 'Erik Gustaf Geijer' (1902).

GEIJERSTAM, Gustaf af, Swedish novelist and dramatist: b. Province of Vestmanland, 5 Jan. 1858; d. Stockholm, 6 March 1909. He pursued studies in the Faculty of Philosophy at Upsala 1877–79; entered the career of a writer 1882, and served as literary manager for the Gernandt Publishing House in Stockholm from 1897 to 1902. Geijerstam's earliest work is in the field of the realistic novel. 'Gråkallt' ('Greycold' 1882); 'Fattigt Folk' ('Poor People' 1884; Pt. 2, 1889) and 'Kronofogdens Berättelser' ('The Crown-Sheriff's Tales' 1890) deal with the life of the lower classes. The novels 'Erik Grane' (1885) and 'Pastor Hallin' (1887) represent youthful characters, under the influence of materialistic modes of thought. Geijerstam's work as a dramatist begins with the comedy 'Svärfar' in 1888. He is particularly popular, as a dramatist, in plays dealing with peasant life in Sweden, such as 'Per Olsson och hans käring,' 'Lars Anders och Jan Anders och deras barn' ('Per Olsson and his Old Woman,' 'Lars Anders and Jan Anders and their children,' 1894), and as the author of the comedy 'Stiliga Augusta' and the fairy-play 'Stor Klas och Litt Klas.' He returned to the novel in 1895, producing a number of less realistic works, including 'Medusas hufvud' (1895); 'Kampen om Kärlek' (1896); 'Vilse i lifvet' (1897); 'Det yttersta skäret' (1898); 'Aktenskapets komedi' (1898); 'Lyckliga människor' (1899); 'Kvinnomakt' (1901); 'Nils Tuvesson och hans moder' (1902); 'Skogen och sjön' (1903); 'Själarnas kamp' (1904); 'Karin Brandts Dröm' (1905); 'Bröderna Mörk' (1906); 'Den eviga Gatan' (1907). Two works are autobiographical in character: 'Boken om Lille-Bror' (1900), and 'Mina pojkar' (1907). None of Geijerstam's works has been printed in English translation, but there is a collected edition in German.

JACOB WITTMER HARTMANN.

GEIKIE, gē'kĭ, SIR **Archibald,** Scottish geologist and scientific writer: b. Edinburgh, 28 Dec. 1835. He entered the Geological Survey in 1855 and has since had a brilliant career of discovery and experiment and held many important posts. Among his publications are 'The Story of a Boulder' (1858); 'Elementary Lessons in Physical Geography'; 'Scenery of Scotland Viewed in Connection with its Physical Geology'; 'Outlines of Field Geology'; and 'Text-Book of Geology' (3d ed., 1893); 'The Ancient Volcanoes of Britain' (1897); 'Types of Scenery' (1898); 'Scottish Reminiscences' (1904); 'Landscape in History' (1905); 'Charles Darwin as Geologist' (1909); 'The Love of Nature Among the Romans' (1912).

GEIKIE, James, Scottish geologist, brother of Archibald Geikie (q.v.): b. Edinburgh, 23 Aug. 1839; d. 1 March 1915. He was educated at Edinburgh University in which he held the chair of geology from 1882 until his death. He is the author of 'The Great Ice Age' (1874); 'Prehistoric Europe' (1882); 'Outlines of Geology' (1884); 'Fragments of Earth Lore' (1892); 'Earth Sculpture' (1898); 'Structural and Field Geology' (1905); 'Mountains, their Origin, Growth and Decay' (1913); 'The Antiquity of Man in Europe' (1913).

GEIKIE, John Cunningham, English Anglican clergyman: b. Edinburgh, 26 Oct. 1824; d. Bournemouth, 1 April 1906. He was educated at the University of Edinburgh and Queen's College, Kingston, Ontario, was pastor of Presbyterian churches in Halifax and Toronto, was ordained priest of the Established Church in 1876, and was successively curate of Saint Peter's, Dulwich, 1876–79; rector of Christ's Church, Neuilly, Paris, 1879–81; vicar of Saint Mary's, Barnstable, 1883–85; and vicar of Saint Martin-at-Palace, Norwich, 1885–90. He earned a wide popularity as a writer on biblical and religious subjects and his works include 'The Life and Words of Christ' (1877); 'Old Testament Portraits' (1878); 'The English Reformation' (1879); 'Hours with the Bible' (1881–84); 'Landmarks of Old Testament History' (1894).

GEIL, gīl, **William Edgar,** American explorer: b. Doylestown, Pa., —. He was educated at the seminary of his native place and at Lafayette College. In 1896 he studied archæology in western Asia. Starting in 1901 he toured all parts of China and in the pigmy forest of Africa and lectured in China, Japan, Australia, Great Britain and the United States. He has published 'Pocket Sword' (1895); 'Laodicea' (1898); 'The Isle that is Called Patmos' (1898); 'Ocean and Isle' (1902); 'A Yankee on the Yanktze' (1904); 'The Man of Galilee' (1904); 'A Yankee in Pigmyland' (1905); 'The Man on the Mount' (1905); 'The Automatic Calf' (1905); 'Cannibals Before and After' (1907); 'The Great Wall of China' (1909–11); 'Eighteen Capitals of China' (1911); 'Adventures in the African Jungle hunting Pygmies' (1917).

GEILER VON KAYSERSBERG, gī'lẽr fōn kīz'ẽrs-bĕrg, **Johann,** Catholic mystic and preacher: b. Schaffhausen, 1 '5; d. 1510. He received his education at Ammersweier and Freiburg, was ordained to the priesthood in 1471 and joined the faculty at Basel, where in 1475 he became professor of theology. In 1476 he was made rector of the University of Freiburg, and two years later was appointed cathedral preacher at Strassburg, where he remained for over 30 years. His principal sermons are contained in the volumes 'Navicula sive Speculum Fatuorum' (1510); 'Das Schiff der Pönitenz' (1514); 'Der Seelen Paradies' (1510); 'Christliche Pilgerschaft' (1512). Consult De Lorenzi, 'Geilers ausgewähte Schriften' (1883); Godeke, 'Grundriss zur Geschichte der deutschen Dichtung' (1884); Dacheux, 'Un reformateur catholique à la fin du XVe siècle' (Paris 1876); Lindemann, 'Johann Geiler von Kaisersberg' (Freiburg 1877); Schmidt, 'Histoire littéraire de l'Alsace à la fin du XVme siècle' (Paris 1879).

GEINITZ, gī'nĭts, **Hans Bruno,** German goelogist: b. Altenburg, 1841; d. 1900. He received his education at the universities of Berlin and Jena; in 1850 was appointed professor of mineralogy at the Dresden Polytechnic Institute, and from 1857 to 1894 was director of the Dresden Museum of Mineralogy. His published works include 'Charakterisk der Schichten und Petrefakten des sachsisch-böhmischen Kreidegebirges' (1843); 'Die Versteinerungen der Steinkohlenformation in Sachsen' (1855); 'Geologie der Steinkohlen Deutschlands und anderer Länder Europas' (1865); 'Carbonformation und Dyas in Nebraska' (1866); 'Geologie von Sumatra' (1875); 'Ueber fossile Pflanzen und Tierarten in den argentinischen Provinzen San Juan und Mendoza' (1876).

GEISHA, gā'shą, a Chino-Japanese word, meaning "one with pleasing accomplishments," applied to Japanese singing and dancing girls who furnish entertainment in tea-houses and at social gatherings.

GEISSEL, gīs'sĕl, **Johannes von,** German Catholic prelate: b. Gimmeldingen, 1796; d. 1864. He was educated in the seminary of Mainz, and in 1818 was ordained to the priesthood. In the following year he became professor at the Speyer gymnasium. In 1836 he was made dean of the chapter, and in 1837 was consecrated bishop. He became coadjutor archbishop of Cologne in 1842 and archbishop in 1845. He became a member of the Prussian Constituent Assembly in 1848 and helped materially in securing liberty to the Church under the new Prussian constitution. He was created cardinal in 1850. He supported the Jesuits and in general the Ultramontane party in the Church and suppressed Hermesianism within his archdiocese. He also brought construction work on the famous cathedral to completion. Consult Dumont, 'Diplomatische Correspondenz über die Berufung des Bischofs Johannes von Geissel' (Freiburg 1880), and the biography by Pfülf (ib. 1896).

GEISSLER, gīs'lẽr, **Heinrich,** German mechanician: b. Igelshieb, Germany, 26 May 1814; d. Bonn, Prussia, 24 Jan. 1879. He became known as a maker of physical and chemical apparatus and principally as the inventor of Geissler's tubes (q.v.), an apparatus for producing light by an electric discharge in vacuo.

GEISSLER'S TUBES, tubes made of very hard glass, and containing highly rarified gases. Each end of the tube has a platinum wire sealed into it to serve as electrodes. When a discharge of electricity is caused to take place in these tubes by connecting the electrodes to the terminals of a Ruhmkorff's coil or a Holtz's machine, very brilliant effects may be produced. The invention was named after Heinrich Geissler (q.v.).

GEIST, gīst, term meaning "spirit," used frequently in the compound *Zeitgeist*, "spirit of the times." In English literature it was first employed by Matthew Arnold.

GEITNER, gīt'nẽr, **Ernst August,** German chemist: b. Gera, 1783; d. 1852. He was for many years director of a chemical works at Löasnitz and in 1815 removed to Schneeberg where he founded another chemical factory of which he remained manager until his death. He discovered the alloy *argentan*, or German silver; made original investigations in dyeing, and was a pioneer in the use of chromic salts for vegetable and animal dyes. He wrote 'Briefe über die Chemie'; and 'Die Familie West, oder Unterhaltungen über Chemie und Technologie.'

GEITONOGAMY. See POLLINATION.

GELA, jē'la, Sicily, a city of ancient Greece, situated on the island between Agrigentum and Camarina; founded in 690 B.C. by the Cretans and Rhodians. The colony was remarkably prosperous, and in 528 B.C. sent out a portion of its inhabitants, who founded Agrigentum. In 280 Phintias, the tyrant of Agrigentum, utterly destroyed Gela.

GELADA, gĕl'ą-dą, a kind of baboon (q.v).

GELASIUS (jē-lā'sĭ-ŭs) **I, Saint,** Pope: d. 19 Nov. 496. He succeeded Felix III on 1 March 492. At the Council of Rome in 496 he distinguished the canonical books from the apocryphal of Scripture. He also regulated the canon of the Mass. He was succeeded by Anastasius II.

GELASIUS II (Giovanni di Gaeta, gä-ā'tä), Pope: d. Cluny, France, 29 Jan. 1119. He was cardinal and chancellor under Urban II and Paschal II and on the death of the latter was chosen Pope by the party hostile to the Emperor Henry V. The imperial party at Rome under the Frangipani seized his person, but were forced to set him free by the menacing attitude of the mob. The new Pope fled before the advancing imperial troops to Gaeta, where he first received his consecration, and whence he excommunicated Henry V and Gregory VIII, the antipope Henry had set up. Soon after he was able to return to Rome, but ere long had to betake himself for protection to France, where he died in the monastery of Cluny.

GELATINE, jĕl'ą-tĕn, or **GELATIN** (Latin, *gelatus*, "frozen," so named from the tendency which the substance has to congeal and become to a certain extent solid), in chemistry a substance also known as animal glutin, obtained by treating bones with dilute hydrochloric acid, which dissolves the mineral constituents of the bone, consisting of phosphates and carbonates of calcium, magnesium, etc., and leaves the bone cartilage. This, when boiled for a long time with water, dissolves, and forms gelatine, which can be purified by dissolving in hot water and precipitating by alcohol. A pure variety known as isinglass is obtained from the swimming bladder of the sturgeon and other fishes. Impure gelatine glue is prepared by boiling down pieces of hide, horn, hoof, cartilage, etc., with water under pressure. Pure gelatine is amorphous, transparent in thin plates, of a yellowish-white color; it has neither taste nor smell, and is neutral to vegetable colors; it is insoluble in alcohol and in ether. In contact with cold water it swells up, and is soluble in hot water. It is not precipitated by acids, except by tannic acid, which gives a flaky precipitate insoluble in water, alcohol and ether. The aqueous solution of gelatine turns the plane of polarization to the left. Gelatine subjected to dry distillation yields methylamine, cyanide of ammonium, pyrrhol, etc.; by oxidation with sulphuric acid and manganese dioxide, or with chromic acid mixture, it yields hydrocyanic acid, acids of the fatty series, benzoic aldehyde and benzoic acid, leucine and glycocol, but unlike most other proteids, no tyrosine. Gelatine boiled with caustic potash yields glycocine and leucine. Gelatine contains about 50 per cent of carbon, 6.6 of hydrogen, 18.4 of nitrogen, 25.1 of oxygen and a small amount of sulphur. Moist gelatine exposed to the air rapidly putrefies, the liquid becoming first acid, but afterward it gives off ammonia. Gelatine gives no precipitate with lead acetate, alum or ferrocyanide of potassium. A mixture of gelatine with potassium dichromate becomes, when exposed to the action of light, insoluble in water. The nutritious value of gelatine has been much overestimated. Gelatine is also made use of in photography (q.v.).

GELATINE PROCESS. See PHOTOGRAPHY; PHOTO-ENGRAVING.

GELCICH, gĕl'tsĭk, **Eugen,** Austrian scientist: b. Cattaro, Dalmatia, 1854. He became director of naval schools at Lussinpiccolo and Triest and since 1902 has been chief inspector of commercial and naval schools in Austria. He wrote extensively on geography and magnetism. His published works include 'Geschichte der Uhrmacherkunst' (5th ed., 1887); 'Estudios sobre el desenvolvimients histórico de la navigación' (1889); 'La scoperta d'América e Christoforo Colombo nella letteratura moderna' (1890); 'Die Uhrmacherkunst und die Behandlung der Präzionsuhren' (1892); 'Die astronomischen Bestimmungen der geographischen Koordinaten' (1904); 'Weichs-Glon oesterreiche Schif-fahrts-Politik und unseres nautisches Bildungswesen' (1912).

GELDERLAND, gĕl'dĕr-länt, **GUELDERS,** or **GUELDERLAND,** a province of Netherlands, with the Zuyder Zee on its northern boundary. Area, 1,906 square miles. The surface is level, the soil of the north sandy, the southern part low, marshy, but, when cultivated, fertile. The principal rivers are the Rhine and the Meuse. The capital is Arnhem (q.v.). Pop. 662,250. Gelderland, or as it was originally known, the county of Gelre, first enters into history as a portion of the empire in the middle of the 11th century. In the 14th century it occupied a leading place among the provinces of the Netherlands. Its rulers, who belonged to the house of Nassau, were raised to the rank of dukes in 1339, but the family soon died out. Gelderland was incorporated into Jülich. Gelderland suffered greatly from the incessant strife of contending claimants to its rule. Charles the Bold of Burgundy was Duke of Guelderland from 1472 to 1477, and from him the duchy passed to Austria, and ultimately to Spain. The greater part of Gelderland — the so-called Lower Gelderland — joined its fortunes with the remainder of the Protestant Netherlands. Upper Gelderland was kept by Spain, but during the War of the Spanish succession was taken by Prussia. Part of it, however, underwent thereafter the successive régimes of Spain, Austria and the Independent Netherlands. During the French Revolution and the Napoleonic era, more or less of Gelderland was under French rule. In 1815 it was divided by the Peace of Vienna between the Netherlands and Prussia. (See NETHERLANDS). Consult Westerate, 'Gelderland in der patriottentijd' (Utrecht 1903).

GELDNER, Karl Friedrich, German Orientalist: b. Saalfeld, Saxe-Meiningen, 1853. He was educated at the universities of Tübingen and Leipzig, removed to Halle in 1887 and three years later to the University of Berlin where he was appointed associate professor of Indo-Iranian languages. He removed to Marburg in 1907 where he holds the chair of Indo-Iranian languages. He has published 'Ueber die Metrik des jüngeren Avesta' (1877); 'Studien zum Avesta' (1882); 'Drei Yasht aus dem Zendavesta' (1884); 'Vedische Studien' (1889–1901); 'Glossar zu den Rigveda' (1907); 'Der Rigveda in Auswahl' (1907); 'Zur Kosmogonie des Rigveda, mit besonderer Berücksichtigung des Liedes 10,129' (1908); 'Vedismus und Brahmanismus' (1911). He edited 'Avesta: the Sacred Books of the Parsis' (1895); 'Grundriss der iranischen Philologie' (2 vols., 1896–1904).

GELE, zhāl, **Alphonso van,** Belgian explorer: b. Brussels, 1849. He was educated in his native city and at the University of Ghent. He went to Africa in 1882 and was appointed administrator of a district adjacent to Stanley Falls. In 1885 he explored the tributaries of the Kongo and traced the course of the Ubangi to long. 23° E. He showed that this river is identical with Schweinfurth's Welle.

GELEE, zhĕ-lā, **Claude.** See CLAUDE LORRAINE.

GELERT, Johannes Sophus, American sculptor: b. Nybel, Schleswig, Denmark, 10 Dec. 1852. He studied in the Royal Academy of Fine Arts at Copenhagen in 1870–75, removed to the United States in 1887, received a gold medal and honorable mention at the World's Columbian Exposition (1893), a gold medal at the Nashville Centennial Exposition (1897), and honorable mention and a gold medal at the Paris Exposition of 1900. His works include the monument to the policemen killed by the Chicago anarchists, Haymarket Square, Chicago; statues of Beethoven and Anderson in Lincoln Park, Chicago; a statue of Grant at Galena, Ill.

GELIGNITE. See EXPLOSIVES.

GELIMER, jĕl'ĭ-mer, or **GILIMER,** the last monarch of the African Vandals, great grandson of Genseric. In 530 he deposed his cousin Hilderic, seized the throne, but was soon afterward defeated at Carthage and Tricamarum by Belisarius, general-in-chief of the Byzantine army. Gelimer was taken captive to Constantinople and forced to walk in a triumphal procession. Subsequently the Emperor Justinian granted him an estate in Galatia, where he spent his remaining years.

GELL, Sir William, English explorer: b. Hopton, Derby, 1777; d. 1836. He received his education at Jesus College, Cambridge. In 1800 he was sent on a mission to the Ionian Islands and in 1814 was appointed chamberlain to Caroline, Princess of Wales, and at the investigation by Parliament into her conduct after she became queen he testified in her favor. He resided mostly in Italy, in Rome and Naples. He devoted most of his time to geographical studies and published 'The Topography of Troy' (1804); 'The Geography and Antiquities of Ithaca' (1807); 'The Itinerary of Greece with a Commentary on Pausanias and Strabo' (1810); 'The Itinerary of the Morea' (1817); 'Pompeiana: or, Observations upon the Topography, Edifices and Ornaments of Pompeii' (1817–19); 'Narrative of a Journey in the Morea' (1823); 'The Topography of Rome and its Vicinity' (1834; new ed., 1846); 'Rome and its Environs' (1834). The British Museum has his original drawings of classical ruins.

GELLERT, Christian Fürchtegott, German professor and author: b. Hainichen, Saxony, 1715; d. 1769. At Leipzig he studied theology and subsequently was connected with the university there in the capacity of teacher and professor. He wrote fables, plays and novels and lectures which attained a wide popularity in Germany. His best work is 'Fabeln und Erzählungen' (1746). His 'Works,' were issued in 10 volumes in 1774 and again in 1867. Consult his 'Tagebuch' (1869) and the life by Döring (Greiz 1833).

GELLIUS, Aulus, Latin author: b. possibly at Rome about 130 A.D. He studied rhetoric at Rome and philosophy at Athens, and practised as a lawyer at Rome. He is the author of 'Noctes Atticæ' (in 20 books), full of interesting observations and quotations, from the best Latin and Greek authors, relating to language, literature, history and antiquities. This work was partly compiled in the winter nights during his residence at Athens. It is now of great value, as the authors from which he drew his materials are in a great measure lost. Among the best editions is that of Hertz (1883–85). The "editio principes" was issued at Rome in 1469; and Gronovius published a critical edition at Leyden in 1706. Numerous other editions have been published. In all of them the eighth book of the original 20 is lacking. An excellent edition appeared in an English translation by Beloe in London in 1795. Consult Foster, 'Studies in Archaism in Aulus Gellius' (New York 1912); Knapp, 'Archaism in Aulus Gellius' (in 'Classical Studies in Honor of Henry Drisler,' New York 1894); Nettleship, 'The Noctes Atticæ of Aulus Gellius' (in 'Lectures and Essays,' Oxford 1885); Sandys, 'A History of Classical Scholarship' (Cambridge 1906).

GELNHAUSEN, gĕln'how-zen, Prussia, town in the province of Hesse-Nassau, on the Kinzig, 25 miles northeast of Frankfort. It is a walled town and contains a 13th century church, a Rathaus, a so-called witches' tower and the ruins of a palace of Frederick Barbarossa, a monument to Philip Reis, pioneer telephonist, who was born here. It was at one time an Imperial city but has long since fallen into decadence. The chief manufactures are those of rubber goods, shoes, cigars, chemicals, organs, sealing-wax, etc. There is a brisk trade in fruit and wines. Pop. 4,900.

GELON, jē'lŏn, tyrant of Gela and afterward of Syracuse: d. about, 478 B.C. He was a scion of a noble family of the former city and succeeded its tyrant, Hippocrates, in 491 B.C. Six years later he made himself master of Syracuse also, which then became the seat of his government, and to which he transferred the majority of the inhabitants of Gela. Gelon refused to aid the Greeks against Xerxes, as they declined to comply with his demand that he should be appointed commander-in-chief. The clemency and wisdom of Gelon rendered him so generally beloved that when he appeared unarmed in an assembly of the people and declared himself ready to resign his power, he was unanimously hailed as the deliverer and sovereign of Syracuse. He seems to have been an enlightened ruler and to have advanced the interests of his dominions. After his death he was long remembered with affection and was regarded as one of the national heroes.

GELOSE, jē'lōs, a pectic substance containing carbon, 42.77; hydrogen, 5.775; oxygen, 51.455, prepared by Payen from a commercial article entitled Chinese moss, which consists of long white threads made up into bundles, and from various seaweeds. It is used for food and is said to be the juice of a lichen growing on trees in the south of China and in the Philippine Islands. The moss, when boiled in water, dissolves, with the exception of 2 or 3 per cent of nitrogenized corpuscles and traces of other matter, and on cooling forms a transparent colorless jelly, which when dried constitutes gelose. It is distinguished from other bodies by certain characteristic reactions.

GELSEMIUM, jĕl-sē'mĭ-ŭm, yellow jasmine, the dried rhizome and roots of *Gelsemium sempervirens*, a southern climbing shrub with a large woody underground stem and dark-green leaves, and bright yellow sweet-scented flowers. It grows from Virginia southward in woods, and mounts to the tops of tall trees. The active constituents contained in the underground stem are two alkaloids, gelsemine and gelseminine, the latter of which is the more potent. Gelsemium is an acute poison, acting both on the sensory and motor end-organs, causing anæsthesia and motor weakness. The early symptoms of large doses are loss of power in the muscles of the eye, causing drooping of the lids, dizziness, drowsiness and disturbance of vision. In poisonous doses there is marked diminution in the force of the pulse and respiration, with difficulty of speech, coldness of the body surface and general loss of skin sensations. Death results from asphyxiation. Its most important medicinal use is in neuralgias, in sick-headache and as a general nerve tonic.

GELSENKIRCHEN, gĕl'sĕn-kĕr-ʜen, Prussia, town in the province of Westphalia, on the Rhine-Herne Canal, five miles north of Essen. It is a thriving industrial centre, with coal mines, iron and steel works, rolling mills, flour and saw mills, boiler works, soap and chemical works, etc. In 1875 it was made a city and in 1903 several suburbs were incorporated with it. Pop. 170,000.

GELVES, hel'vās, **Los,** a small island in the Gulf of Cabes in the Mediterranean. It is famous as the scene of a battle between Spaniards and Turks in 1790. Of about 8,000 Spaniards only 1,000 remained after a siege of eight weeks. It was one of the greatest defeats ever inflicted by the forces of Islam on those of Christendom.

GEMARA, gę-mä'rą, part of the two Talmuds, Babylonian and Palestinian, which contains annotations, and commentaries of the Talmudic law. That of the Babylonian Talmud is more diffuse and is a valuable authority. It was completed about 600 A.D. See TALMUD.

GEMATRIA, a mystic system of scriptural interpretation, consisting in the substitution of, or finding of one word in another, the letters of which have the same numerical value.

GEMBLOUX, zhäṅ'bloo', **Sigebert of.** See SIGEBERT OF GEMBLOUX.

GEMBLOUX, zhäṅ'bloo', Belgium, town of the province of Namur, 25 miles southeast of Brussels. It has a fine Benedictine abbey, dating from the 10th century and now used by the Royal Collége of Agriculture. It contains large railroad repair shops and engine works. In 1578 the Spaniards here defeated the Dutch. Pop. 4,800.

GEMINI, jĕm'ĭ-nī, the Twins (II), the third sign of the zodiac. The sun enters this sign on or about 21 May, and leaves it on or about 21 June. The name belongs also to a northern constellation, of which the two chief stars are Castor and Pollux. They are very nearly equal in brilliancy, which fact probably suggested the name. Pollux is slightly the brighter. It is a quadruple star. Castor is one of the finest of the double stars. Turner discovered in 1903 a star of the 7th magnitude in this constellation; and Enebo, in 1912, discovered, at Domaas, Norway, a second one, of the fourth magnitude. See ASTRONOMY.

GEMINUS, Greek writer: flourished probably in the first half of the 1st century B.C. Rhodes is supposed to have been his birthplace. We possess only one of his works, 'Introduction to Phenomena,' a work on astronomy. It was published together with a Latin translation by Hilderic (Altdorf 1590) and with a French translation by Halma in his 'Chronologie de Ptolémée (Paris 1819). Geminus' best work was the 'Arrangement of Mathematics.' Of this there are a few fragments preserved in Pappus, Eutocius and Proclus.

GEMISTUS, jĕ-mĭs'tŭs, **Georgius.** See PLETHO, GEORGIUS GEMISTUS.

GEMMÆ, jem'mē, various vegetative bodies which form in certain liverworts (q.v.).

GEMMELLARO, jem'mĕl-lä'rō, **Gætano Giorgio,** Sicilian naturalist: b. Catania, 1836; d. 1904. He received his education in his native city and at the University of Naples. He became professor at Palermo and subsequently was rector of the university there. He made original researches in volcanology and Monte Gemmellaro near Mount Etna is named after him. He published 'Descrizione di alcune specie di minerali dei vulcani estinti di Patagonia' (1856); 'Pesci fossilli della Sicilia' (1858); 'Studi paleontologici sulla fauna del calcare a Terebratula janifor' (3 vols., 1876); 'La fauna dei calcari' (1899); 'I crostacei dei calcari' (1890); 'I celalopodi del Frias superiore della regione occidentale della Sicilia' (1904).

GEMMI (gĕm'mē) **DIE,** Switzerland, a narrow pass, nearly two miles long, which crosses the Alps at a height of 7,553 feet, and connects the Swiss cantons of Bern and Valois.

GEMMULES, jĕm'ūlz. (1) In actual biology gemmules are aggregations of cells set apart in the body of sponges and polyzoans to serve as reproductive agents. They are actually the lowest unit in organic life, the most primitive form of reproduction. (2) In philosophical biology gemmules are hypothetical, self-reproducing particles in the reproductive protoplasm (a structure which is assumed) supposed to be bodily transmitted from parent to child, and to carry such qualities as are inherited by offspring. The word gemmules originated with Darwin. Herbert Spencer in 1864 called them *physiological units;* Haeckel and Erlsberg gave them the name of *plastidules;* Nägeli applied the term *micellæ;* Detmer, *Lebenseinheiten* or vital units; Hugo de Vries, *pangens;* Verworn, *biogens;* and Weismann, *biophors,* which by combining make up the units in the next scale above them or *determinants,* which in their turn *ids* and ids *idantes.* W. Roux named his elementary units *metastructural parts;* Haacke, *gemmæ;* and Weisner, *plasomes.* See BIOLOGY; EMBRYOLOGY.

GEMOT, gę-mōt', an assembly of freemen among the Anglo-Saxons convened both for legislative and judicial purposes. The term in time came to designate any formal gathering, and even local assemblies or moots. Such were the shire-gemot, or county court, burg-gemot and halle-gemot, which were held monthly. The great council of the nation was known as the witenagemot. The word moot is derived from gemot. A clash of arms was the usual mode of signifying approval of a proposition and grows to express its rejection or disapproval.

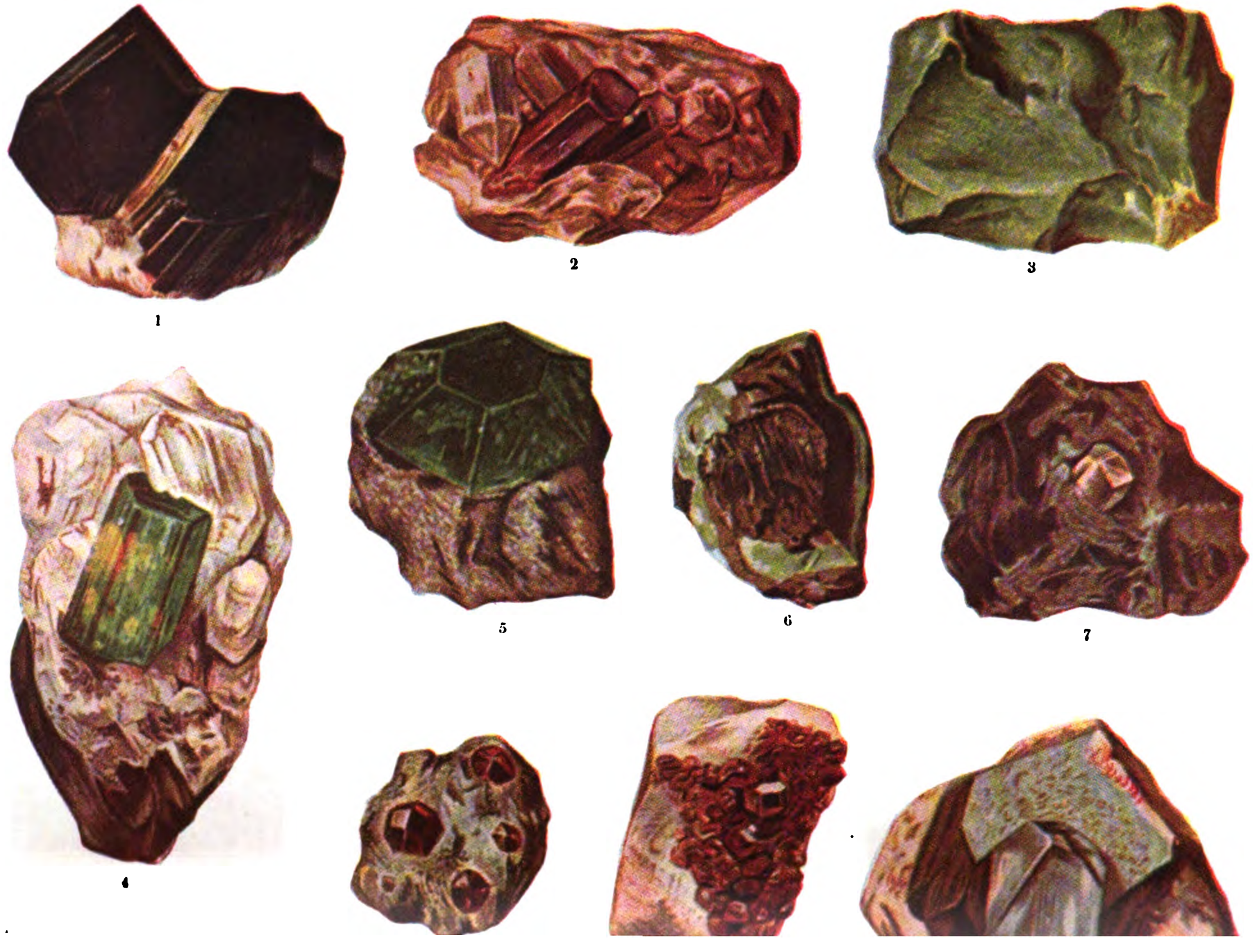
GEMS. See MINERAL PRODUCTIONS OF THE UNITED STATES; PRECIOUS STONES.

GEMS, Engraving of, the glyptic art, gem sculpture or lithoglyptics; the art of representing designs on precious stones, either in raised work (cameos), or by figures cut into, or below the surface (intaglios). The latter method was practised at a very early period, the oldest examples being the engraved cylinders found in Mesopotamia, and, more rarely, in Egypt. The art dates from at least 4000 B.C. and perhaps a millenium earlier. While there is no means of determining exactly whether it originated in Egypt or in Babylonia, the records and the remains we possess seem to indicate that it was first practised by the Sumerians, who developed a high civilization in Babylonia before the advent of the Semites in that region, and that it was thence brought to Egypt. The designs represent divinities and objects of traditional or religious significance and the cylinder was pierced so that by passing a cord through the aperture it could be worn suspended either from the neck or from the wrist. It seems quite probable that at the outset these engraved cylinders were worn to satisfy a religious or superstitious belief, but an almost equally prevalent use, and one that soon came to be the predominant one, was for personal signets, the so-called "rolling-seals," for by rolling one of them over a surface of freshly-baked clay, the impression of the intaglio would appear thereon in relief. The concave shape of the earliest cylinders hence indicates that the clay bricks on which they were pressed curved up toward the centre, while the slightly barrel-shaped cylinders sometimes made in Persian times were adapted for use on bricks of concave form. In Egypt the cylinder was at a very early period supplanted by the scarab seal, the precious material being given the figure of the sacred beetle (*Scarabæus sacer*), with the legs closely drawn up beneath the body.

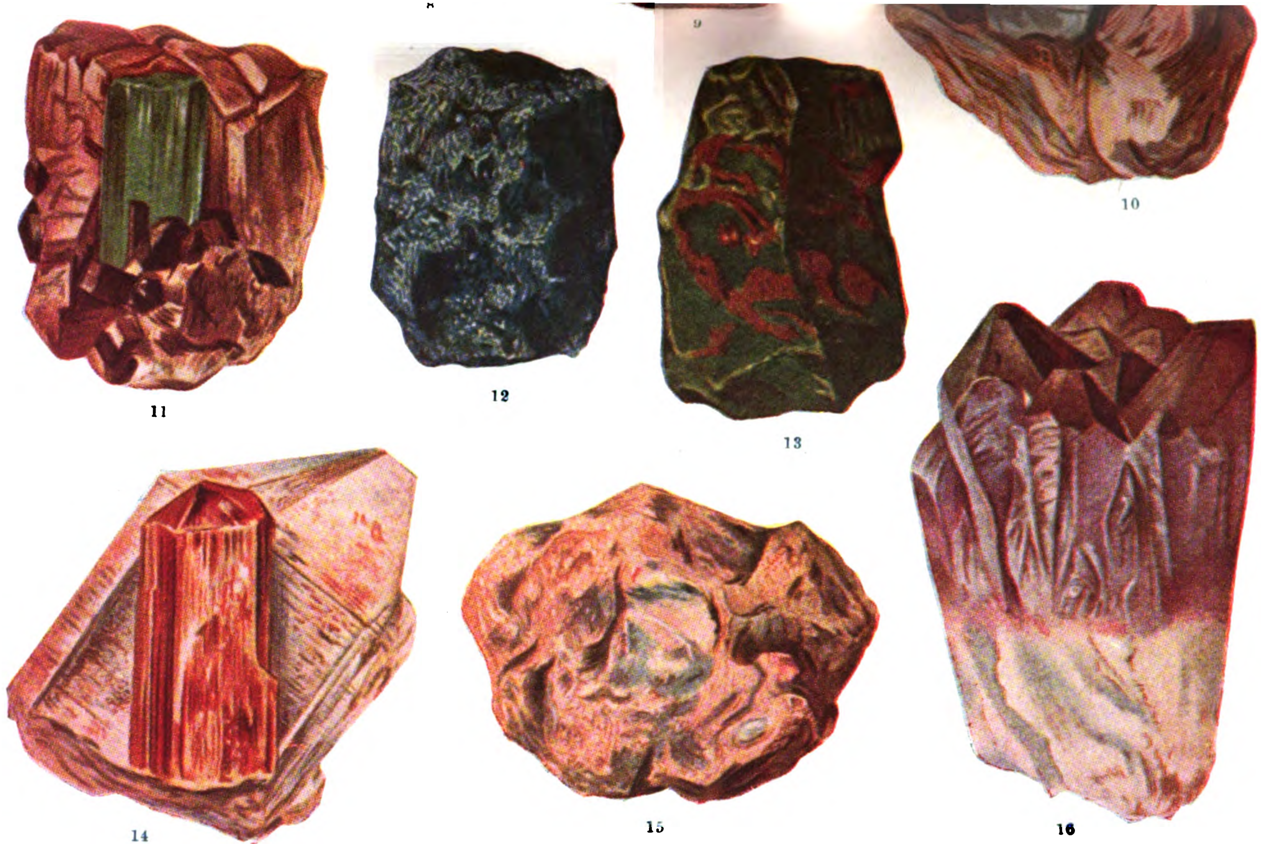
The first Babylonian seals antedated the use of writing, the designs representing divinities and symbolical objects, being so differentiated as to constitute each seal a personal mark; later on, with the invention of a form of writing, the design was frequently supplemented by the characters denoting the name of the owner, and often by a brief invocation of one or more of the gods. Dr. Stewart Culin has conjectured that the cylindrical form may have been suggested by the still earlier use of short joints of reed for the same purpose. The earliest Babylonian cylinder seals that have been preserved are made of the core of a soft conch shell, or of a soft serpentine. In either case no special graving tools were needed. Later, however, from about 3000 B.C., many silicious stones were used, such as jasper and chalcedony, and it is probable that the cutting tool employed was tipped with a fragment of corundum. Until about 1500 B.C. all the work was done with a free hand, there being no indication of the use of the revolving wheel at an earlier date. Other materials used for the early Babylonian cylinder seals were lapis lazuli, amazonite and white marble, and, somewhat later, from about 2000 B.C., hematite and the blue chalcedony known as saphirine. Still later, several other stones were employed, there being even a very few jade cylinders.

Gem-cutting in the Greek world dates from at least 2000 B.C., and was first highly developed in Crete, this "Minoan" art having its best period from about 1800 B.C. to 1600 B.C., and flourishing down to about 1200 B.C. The Mycænean art of the Greek mainland had almost as early beginnings and flourished up to perhaps 1000 B.C., its best period being 1600–1400 B.C. The term "Ægean gems" is sometimes used to cover both those of Cretan and those of Mycenæan art. Later than this comes the so-called Archæic Greek art (600–480 B.C.), to be succeeded in turn by the best period of Greek gem-cutting, dating from about 480 B.C. to 400 B.C. Already in the time of Solon the custom of incasing cut stones as seal-rings appears to have been general among the Greeks. One of the earliest artists in this branch of whom mention is made is Mnessarchus, the father of the philosopher Pythagoras, and consequently a contemporary of that Theodorus of Samos who engraved the famous emerald signet set in the ring of Polycrates, of which such wonderful stories are told by ancient authors. These early works were probably intaglios; the artist made use of the lathe, the corundum-point — possibly of the diamond point also; indeed some have believed that diamond dust was used. However this very early use of diamond is questionable, as there is no proof that it was known to Europe at such an early date. In the 4th century the most renowned gem-cutter seems to have been Pyrgoteles, to whom Alexander the Great gave the exclusive privilege to engrave his likeness. The artists, whose names are but rarely engraved on their works, often took the masterpieces of sculpture for their subjects and models. Under the Roman emperors, in particular, this was quite common. The chief early Greek engraver whose name is known from extant works of his is Dexamenos of Chios (late in the 5th century). The gem engraved by Dexamenos the Chian, and bearing his full signature, was found at Kertch (the ancient Panticapæum) in the Crimea. It is a scaraboid, and shows a representation of a flying stork (*pelasgos*) the national emblem of Chios. This unique gem is in the great collection of the Hermitage at Petrograd. (C. W. King, 'Antique Gems and Rings,' London 1872, p. 408). The names of Dioscorides, Apollonides, Aulos, Hyllos, Cneius, Solon, Evodus, remind us of some of the most perfect works of this branch of art, but many of the signed gems are forgeries, or old gems with famous names forged on them. However, no distinguishing names are borne by some of the greatest ancient works — the famous sardonyx of the Bibliothèque Nationale (Paris); the apotheosis of Augustus, at Vienna; the onyx at The Hague, representing the apotheosis of Claudius; Achilles lamenting Patroclus; the head of Julius Cæsar — these like the Brunswick vase and the Trivulcian and Neapolitan cups, do not perpetuate the names of the artists. However two of the finest antique cameos of the Bibliothèque Nationale are signed: the head of Mæcenas cut on an amethyst by Dioscorides and the fine cameo bearing the head of Julia, daughter of Titus, done on an aquamarine by Evodus. Pompey consecrated the dactyliotheca, or collection of rings of Mithridates, as a votive offering in the capitol, and Julius Cæsar, six tablets with six gems in the temple of Venus at Rome. At a later period the collections of Herodes Atticus, of Vespasian, etc., were celebrated; yet this general taste was not able to preserve the art from decline. One of the most noted antique gems, a head of Medusa carved in a boss of translucent chalcedony, probably executed for Emperor Hadrian, was in the famous Marlborough collection. It was sold at Christie's in September 1918 for $8,750. The finest of the Marlborough gems, however, the splendid sardonyx cameo depicting the "Hymeneal Procession of Eros and Psyche," is now in the Boston Museum, which acquired it in 1899, for $10,000. A most interesting class of gems was those produced under the influence of the Gnostic heresy, in the 2d and 3d centuries B.C. These are commonly known as Abraxas gems or Basilidian gems, the former

PRECIOUS GEMS AS THEY ARE FOUND



1 2 3 4 5 6 7



1 TOURMALINE (New York)
2 TOURMALINE (Ural)
3 CHRYSOPRASE
4 EMERALD (Peru)
5 CHRYSOBERYL (Ural)
6 TURQUOISE
7 DIAMOND
8 SPINEL RUBY
9 GARNET
10 TOPAZ (Ural)
11 AQUAMARINE (Ural)
12 LAPIS-LAZULI
13 BLOODSTONE
14 TOPAZ (Brazil)
15 OPAL
16 AMETHYST

designation referring to the symbolic figure representing the divine principle Abraxas, and the latter to Basilides, the leading spirit in the founding of the principal Gnostic sect.

That, however, gem-cutting still persisted in the Western world to a small extent is proved by historic records, as well as by a few engraved gems in bishops' rings, up to the end of the 7th century. In the 9th century, with the advent of the Carolingians, there seems to have been a limited revival. At this time rock crystal was the stone preferably chosen, the finest example being the "crystal of Lothair" now in the British Museum, on which an artist has engraved scenes from the story of Susannah and the Elders. The work was probably done for Lothair II (855–69). After this brief revival the political disintegration in Europe discouraged the development of art, and during the 11th and 12th centuries, and up to the middle of the 13th century, gem-engraving appears to have almost died out in the West, although in a decadent form it still persisted in the East.

The Early Renaissance saw a timid revival, scattered notices from about 1315 to 1450 mentioning briefly the names of a very few engravers on gems. One of the earliest appears to have been Benedetto Peruzzi of Florence, who flourished about 1379, and who is said to have cut an imitation of the seal of Charles of Durazzo. Perhaps better authenticated is Vittore Pisanello, who lived about 1406 in Florence. Among the Germans the earliest that is noted is Heinrich (or Daniel) Engelhard of Nuremberg, a friend of Albert Dürer, who died in 1512. The discovery of some fine antique specimens in Italy, particularly in Florence, and the display of gems by the Emperor Palæologus, at the Council of Florence in 1438, were perhaps the original cause of the taste of the Medici for engraved stones. Forerunners as patrons of gem cutters, and as collectors of gems, were the Popes Martin V (1417) and Paul II (1464). A Florentine artist, generally called on account of his great skill in engraving carnelians, Giovanni delle Carniole (1470–aft. 1516), distinguished himself in this early modern period. There are few gems which can be ascribed to him with any confidence, except the famous carnelian in the Uffizi, at Florence, bearing the portrait of Savonarola, and the inscription *Hieronymus Ferrariensis ordinis prædictorum, profeta vir et martyr.* This stone, which must have been engraved later than 1498, is given in D'Agincourt's great work. Contemporaries and rivals of Giovanni were Nanni di Prospero delle Carniole, in Florence, whom Francesco Salviati directed in his works, and Domenico dei Camei (of the Cameos), a Milanese, whose portrait of Duke Ludovico Sforza, called Il Moro, cut in a balas-ruby, is still preserved in the Uffizi at Florence.

Perhaps the most prolific gem engraver of this period was Valerio Belli, surnamed Il Vicentino (1460–1546); he was employed by Popes Clement VII and Paul III. Another celebrated engraver was Giovanni Bernardi di Castelbolognese, who worked for Duke Alfonso of Ferrara and was the first of these early Renaissance engravers to sign his work. This art found patrons in all the Italian princes, the number of artists constantly increased and the sphere of their art was extended. A most interesting application of it was in the engraving of the indomitable diamond, the first work of this kind being attributed to Clemente Birago of Milan, who is stated to have cut a portrait of Don Carlos, son of Philip II, on one diamond and the Spanish coat-of-arms on another; a rival claimant to the first exercise of this difficult art is Jacopo da Trezzo, also a Milanese; Jacobus Thronus is said to have engraved on a diamond a portrait of Queen Mary I of England. The names of many of the engravers are not known, because they were but rarely put on the stones. Many gems, too, are still concealed in the cabinets of the wealthy or the treasuries of princes. Till these are accurately described, as are those of the Ambrosian collection, it will be difficult to obtain a complete general view.

Subjects of antiquity especially appealed to the artists of the 15th, 16th and 17th centuries, who treated them with such ability that it often requires the skill of the most accomplished connoisseur to distinguish them from genuine antiques. The dispute concerning the so-called "Signet of Michelangelo" is well known. It is not improbable that this carnelian is the work of Pier Maria da Pescia, to whose name the figure of a boy fishing (*pescia*) makes punning allusion. This artist belonged to the age of Leo X, as did also Michelino, another noted gem-cutter. In order to give the gems more completely the appearance of antiques, some artists engraved their names on them in Greek characters, but with so little knowledge of the language that they sometimes betrayed themselves by this artifice. To this time we must ascribe the gems with the name Pyrgoteles, which Fiorello endeavors to prove were the work of an Italian of Greek descent (Lascaris).

The art of engraving was also applied to glass and gold. The crystal box of Valerio Belli, the most skillful and industrious artist in this branch during the 16th century, deserves particular mention. It was intended by Clement VII as a present to Francis I, when Catherine de' Medici went to Marseilles in 1533. At present it is in Florence. The Milanese particularly distinguished themselves in gem-sculpture, as the wealth of the principal citizens of Milan enabled them to patronize this art. Jacopo da Trezza, the same artist who in 1564 executed for Philip II the famous tabernacle of the Escurial, is, as we have noted, said by some to have made in Milan the first attempts at engraving on the diamond. The greatest cameo work of modern times is the stone in the Florentine Museum, seven inches in breadth, on which Cosmo, Grand Duke of Tuscany, with his wife, Eleonore, and his seven children are represented. A Milanese, Giovanni Antonio dei Rossi, who was a contemporary of the Saracchi family (about 1570), is the artist. The Saracchi were five brothers, and the crystal helmet of Albert of Bavaria is a proof of their skill.

Gem-engraving was popular in the 18th and 19th centuries in Italy, Germany and England; the most proficient in France was Jacques Guay, court engraver to Louis XV; the French engraver Siries and the German engravers Natter and Pichler did much of their work in Italy. Toward the end of his life Natter was employed in England, where the English engraver Marchant (1755–1812) may be considered to have been the most artistic of the native gem-cutters of the period. The best-known engraver in England in the first half of the 19th century was Benedetto Pistrucci (b. in Rome 1784); his two daughters Elena and Maria Elisa practised the art in Rome. Notable 18th century engravers are Antonio Berini, a native of Rome, who with Cervera and Giromelli at Rome, and Putinati, at Milan, produced very fine works. In our own times the demand for cameos and intaglios in the United States was greatest from 1870 to 1880. During that time more than 100 workmen found employment here,— many of them as portrait artists. Among these was Lebrethon, who had as a pupil our great sculptor, Augustus Saint Gaudens; another, Zöllner, who engraved some fine and important cameos, took up brass working. Perhaps the greatest artist and the most active, L. Bonet, has to-day scarcely one-sixth of his time occupied, whereas in the "Cameo Age" he required the aid of nine assistants. Some excellent work has been done in New York by Ottavio Negri, formerly of Rome. In 1903 there appeared a slight revival of the wearing of antique and old-fashioned cameos of rather a pronounced form, and quite possibly the glyptic art is destined to experience a return of popular favor.

A few of the famous collections of engraved gems are the Rev. C. W. King collection of antique gems, of the types used in his works, and the Cesnola and other collections, at the Metropolitan Museum of Art, New York city; a fine collection at the Boston Museum of Fine Arts; while the Walters collection, at Baltimore, Md., contains many of the finest gems in America. In Europe the first rank is taken by the collections of the British Museum, of the Cabinet des Medailles (Bibliothèque Nationale), Paris, and of the Imperial Museum in Vienna, to which must be added the Royal Collection at Windsor Castle, and those of the Uffizi Gallery at Florence, of the National Museum at Naples, of the Hermitage in Petrograd and of the Antiquarium, Berlin.

In the course of the centuries, almost all precious stones, as well as some other substances, have been utilized by the gem-engravers. It has already been noted that some of the oldest Babylonian cylinders, engraved from 5,000 to 5,500 years ago, were of shell. Of the stones, the earliest to be used was soft serpentine, but soon the harder serpentines, aragonite, lapis-lazuli, chalcedony, the jaspers, quartz crystal, anhydrite, marble and hematite, as well as, rarely, jade were utilized. To these must be added, for cylinders of later date, certain other materials, such as micaceous iron, gneiss and blue and green glass. Among the Hittite, Assyrian, Cypriote, Syro-Hittite, Sabean, Phœnician, Early Persian and Sassanian cylinders, appear, in addition to the materials already mentioned, red and pink sard, rose quartz, carnelian, matrix-emerald, the blue chalcedony called saphirine, and steatite, besides basalt, iron ore and iridescent glass. The J. Pierpont Morgan collection contains examples of all these materials. In the collection of Babylonian and Assyrian cylinders gathered together by the present writer for the Morgan collection of the American Museum of Natural History in New York are to be found the following materials: Ruin agate, amazon-stone, serpentine, hematite, aragonite, lapis-lazuli, jasper, shell, rock crystal, steatite, anhydrite. the translucent chalcedony with round red spots that has been called "Saint Stephen's Stone," jaspery agate, marble and amethyst. For their engraved scarabs the ancient Egyptians especially favored lapis-lazuli, carnelian, hematite, red and green jasper, garnet, amethyst, and green feldspar, as well as red porphvry and basalt.

A few specimens of royal Babylonian cylinders exist, one of the more interesting being in the J. Pierpont Morgan collection. It is of green serpentine, dates from about 2450 B.C., and is inscribed with the name of Gudea, ruler of Lagash (Shirpurla), and with that of "Abba the scribe, thy servant"; thus it bears both the name of the one who stamped the royal seal on a document or record, as well as that of his sovereign. Another royal seal in this collection, one made of black serpentine, is engraved with the name of Ine-Sin, king of Ur, about 2700 B.C., and who styles himself "servant of the god Adar." Still another Babylonian cylinder is notable as well for its material as for design and inscription. It is of jade (nephrite) and dates from the period between 2000 and 1500 B.C. On it is figured the goddess Ishtar, one foot advanced and resting on a lion, or dragon; above her shoulders rise the shafts of arrows from the quivers on her back. In one hand she holds the Babylonian caduceus, with its two serpents, in the other the serpent scimitar. Facing her is the god Martu, followed by the goddess Shala. The inscription proves that this was the seal of Imgur-Sin, who was "The anointer" in the temple of Belit (Ishtar), and who proclaims himself "the servant of the goddess Bau," consort of the god Ningirsu.

In Græco-Roman and later times, while many of the precious materials in early use were still employed by engravers, we have engraved emeralds, such as that in the ring of Polycrates, as well as engraving on aquamarine and other beryls. To these must be added sard, sardonyx, nicolo and onyx, which have been used more often for engraving than any other stones. Carnelian, almandine and other garnets, notably the fiery-red pyrope garnet often designated "carbuncle," have been also highly favored, as was topaz. Still other stones used were amethyst and other quartz gems, as well as turquoise, jacinth, plasma and infrequently opal. The corundum gems were more sparingly employed, as their great hardness defied the tools of the earlier engravers, and they were not favored, though very occasionally used, in the Renaissance period, as was even the diamond (q.v.), partly because of the mechanical difficulty of engraving on them, and partly because of the value and beauty of the unengraved stones. Still we have, as far back as the later Roman period, the signet of the Eastern Emperor Constantius II (317–61), engraved on a sapphire weighing 53 carats. It is worth noting that shell, the earliest material used by the engravers, was the one most employed in the revival of interest in cameo-cutting in the first half of the 19th century, and one that was freely used in the 17th and 18th centuries.

Bibliography.— d'Agincourt, J. B. S., 'Sculpture'; Mariette, P. J., 'Traité de Pierres

Gravées'; Bellerman, 'Urim und Thummim, die ältesten Gemmen'; King, 'Antique Gems and Rings,' 'Handbook of Engraved Gems'; Middleton, 'The Engraved Gems of Classical Times'; Cicognara, 'Storia della Scultura'; Natter, 'Traité de la Méthode Antique de Graver en Pierre Fine, Comparée avec la Méthode Moderne'; Babelon, 'Le Cabinet des Antiques à la Bibliothèque Nationale'; Ward, William Hayes, 'Cylinders and other Ancient Oriental Seals' (in the library of J. Pierpont Morgan); Osborne, Duffield, 'Engraved Gems'; Dalton, O. M., 'Catalogue of Engraved Gems of Post-Classical Periods in the British Museum.'

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GEMS, Mythology of. The ancients believed that each month of the year was under the influence of a precious stone, and in modern times this superstition has found many devotees. It is quite the prevailing custom in many fashionable European capitals to wear birth-month stones, in preference to other jewels. The following list has been current for many years:

January	Garnet	Constancy
February	Amethyst	Sincerity
March	Bloodstone	Courage
April	Diamond	Innocence
May	Emerald	Success in love
June	Agate	Health and long life
July	Cornelian	Content
August	Sardonyx	Conjugal felicity
September	Chrysolite	Antidote to madness
October	Opal	Hope
November	Topaz	Fidelity
December	Turquoise	Prosperity

The seven gems which are supposed to be under the influence of the seven chief planets are these:

Saturn	Onyx
Jupiter	Cornelian
Mars	Diamond
Sun	Sapphire
Venus	Emerald
Mercury	Loadstone or lodestone
Moon	Crystal

The legend of the diamond tells how Diamond was the name of a beautiful youth of the island of Crete, who was one of the attendants of the infant Jupiter in his cradle. Diamond, not to be subject to «the ills that flesh is heir to,» was transformed into the hardest and most brilliant substance in nature. The diamond among the ancients had the virtue of bestowing victory and fortitude. It calmed anger and strengthened wedded love; hence it was called the stone of reconciliation. The diamond, too, among the Greeks, was a symbol of severe and inexorable justice and of the impassibility of fate. Hence the judges of Hades were described as having hearts of adamant.

GEMSBOK, gĕmz'bŏk, a large South African antelope (*Oryx gazella*), gray in general hue, but along the back, on the hindquarters, and along the flanks the color is deep black. It has a short erect mane, a long sweeping black tail and long sharp-pointed heavy horns, nearly straight from base to tip, and obscurely ringed throughout the lower half. It is asserted that the gemsbok never drinks water, the moisture which it needs being obtained from the succulent bulbous plants on which it feeds. It is one of a group of large antelopes, including the oryx, beisa and addax, which are sometimes called the gemsboks, and the numbers of all which are rapidly diminishing toward extinction. See ANTELOPE.

GEMÜNDER, August, ow'goost gĕ'münde, German-American violin-maker, brother of George Gemünder (q.v.): b. Ingelfingen, Würtemberg, 1814; d. New York 1895. He studied the art of violin-making with Vuillaume at Paris. From 1846 to 1860 he was at Springfield, Mass., where he won wide recognition for his violins; and in 1861 established his business in New York. His most important work was a copy of an Amati owned by Pablo Sarasate, the well-known Spanish violinist, who declared it equal to the original instrument.

GEMÜNDER, George, German-American violin-maker, a brother of August Gemünder (q.v.): b. at Ingelfingen, Germany, 1816; d. New York 1899. He was a pupil of Baptiste Vuillaume of Paris, came to America in 1847, won the first prize with his violins at the Crystal Palace exhibition, London (1851), and in 1873 sent to the Vienna exhibition a copy of a Guarnerius declared by the jury of experts to be an original. It is said that his were the finest violins yet made in America. He published 'George Gemünder's Progress in Violin-Making' (Astoria, N. Y., 1881).

GENALA, jä-nä'lą, **Francesco,** Italian statesman: b. Soresina, Cremona, 1843; d. 1893. He studied law and was admitted to the practice of his profession at Florence, where he resided after 1862. He organized the city finances there and in 1871 published his well-known work, 'Rappresentanza proporzionale.' He entered the Chamber of Deputies as a member of the Left; was made Minister of Public Works in 1883 under Depretis and again under Giolitti in 1892–93. He originated the plan for the lease of the national railways to private corporations which was adopted in 1885.

GENAVA, See GENEVA.

GENAZZANO, jä'nat-sä'nō, Italy, town in the province of Rome, situated in the Sabine Hills, 25 miles east of the capital. It is the seat of Il Capello della Madonna del buon Consiglio, a renowned place of pilgrimage, and contains also the ancient castle of Colonna. Pop. 4,200.

GENDARMES, or **GENS D'ARMES** (zhôn'därm), Fr. plur. of gendarme, meaning man-at-arms. The Gens D'Armes are horse soldiers in full armor when they first appear in history. They were originally mounted lancers, attended by five inferior soldiers, who were furnished by the holders of fiefs; these were replaced by Charles VII's compagnies d'ordonnance, which were dissolved in 1787, one company gendarmerie being retained as the body-guard of Louis XVI. Since the French Revolution, except for a short interval at the Restoration, the gendarmes have constituted a military and rural police, which superseded the old maréchaussée, and comprises both cavalry and infantry; divided into legions and companies, and these latter into brigades, the organization of the force corresponds to the territorial divisions of the army. The men receive higher pay than the rest of the army, of which, however, the corps is a part, its members being drafted from the line for this service. Germany also since 1808 has had its gendarme. See POLICE.

GENDER, in grammar, a difference in the forms of words to express distinction of sex, whether real or fictitious. Some languages are rich in such forms, others are altogether lacking in them. In the strictly grammatical sense of the word the latter languages are without gender. Primarily there are only two genders, masculine and feminine, corresponding to the natural divisions of sex, male and female. In very early times man seems to have regarded all the world as animate, even the rivers and clouds, the sun, moon and stars, and the still more inanimate things such as earth, sticks stones, the atmosphere, sunshine, fire and water, light and darkness. Abstract qualities, too, were considered as living and very active beings. All nature being animate to the mind of primitive man, there was no room in his world for more than two genders, masculine and feminine, corresponding to the male and female beings of his associations or of his imagination. As he never pictured anything as being inanimate he could have had no conception of or use for a neuter gender. It was only when man began to doubt that some of the forms of nature were endowed with life and volition that the necessity arose for grammatical forms to express this difference. Many of the more primitive languages, notably those of the American continents, have never reached this latter stage. Most grammarians class these latter as having no gender; but they really form the best examples of primitive gender making. A language does not necessarily require to be primitive to be in this stage. But it is necessary that the people using it shall not have passed beyond a certain stage of development; for language is the reflection of the mind of thinking man. As the mind becomes more complex it invents grammatical forms to express this complexity of thought and relationship. Primitive gender was expressed in a very simple manner, generally by attaching to the common noun, the word «man» or «woman,» «male» or «female» or their equivalents. Thus man-child, woman-child, male-child, female-child, are true cases of gender, since they are grammatical distinctions in the use of words. In this early stage of a language a word might be of common gender; but it was never neuter, in the sense that implies the absence of the distinction of gender or of the masculine or feminine qualities. The gender was simply expressed as common or more properly, disregarded on occasions when no necessity arose to assert the male or female attributes of the object designated. In the course of time, as man's conception of the true condition of inanimate nature changed, it is probable that the less active words became neuter, expressing the idea of no sex and, later still, no volition; while those expressing living beings who did not enter actively or seriously into man's life were expressed by the common word alone without the gender designation. But before this happened a long period of evolution had to take place. Even in such a highly developed and inflected language as Anglo-Saxon, not only are the primitive gender forms strongly in evidence, but also the forms by which the idea of neutrality in gender are expressed are plainly in evidence. The word *mann* was still of common gender; but it did not express the human race, since to convey this idea, the word *cynn* had to be added to it, thus forming the collective noun *manncynn,* mankind, a strictly non-gender word, in its original conception. The wæpenmann, the weapon being, was the male being, or man, in the modern sense of the word. Here we see how adjectives, which were expressive of activities of the nouns to which they were attached, came, in some languages, to have masculine and femine forms. Wæpen being the symbol of militant man, came to have the adjective meaning of male or masculine; and wæpenlic was manlike, or masculine. *Wifa,* in Anglo-Saxon signifies woman; but wife-child is a female child or girl. A being that, while human or endowed with animal life, is yet neither male nor female, that is a hermaphrodite, is called wæpenwifestre, that is an armed female or a male-female.

In the strictly grammatical sense, English is a non-gender language, as it possesses no form of words distinctive of sex. *Boy* represents a male being, *girl* a female being; but there is no grammatical form assumed by either word which enables us to say that it is masculine or feminine. In order to arrive at this knowledge we must go beyond the province of grammar and find the meaning and use of each word. It is customary to say that boy is of the masculine gender because it represents a male being; but this is equivalent to saying that a thing is what it is because it is what it is. It is an admission of the fact that modern English grammar has no forms of words by which it distinguishes sex; and that, if we wish to distinguish the sex of the being represented by any definite word we must have recourse to our own knowledge of its meaning or, in default of this, to the dictionary. We know that wife is feminine because it represents a female being; but we do not know this by virtue of its grammatical form. In the Latin languages, on the contrary, the grammatical distinction is practically always in evidence. Thus, for example, «esposo,» in Spanish is husband and «esposa» is wife. The «o» ending denotes the male being and the «a» the female being. Our grammatical knowledge tells us that the one is masculine and the other feminine without the necessity of knowing the meaning of either word. Here grammar is independent of the dictionary. «Criado» is masculine because it has the grammatically masculine termination «o» while «criada» is feminine because it has the grammatically feminine termination «a.» To arrive at this conclusion it is not necessary to know in advance that «criado» is a male servant and «criada» a female servant. The word servant has, in English, no form to express gender; and to convey the idea of gender we have to have recourse to the old English method of prefixing to it words indicative of sex, as for example, man-servant, maid-servant, woman-servant, girl-servant. If this method were used consistently throughout, then the English language might properly be said to possess grammatical gender. Our lack of true grammatical gender is shown in our recourse to such expressions as man child, male child, boy pupil, girl pupil, man teacher, male teacher, woman teacher, female teacher. These efforts are the survival of a very ancient method of the language used to express grammatical gender. But they now exist only as curious survivals of the past and as an almost negligible exception to the rule that English is a non-gender language.

Old Gender Forms.— There linger in the English language many old forms reminiscent of its early history and its long transitional period. Some of these indicate grammatical gender in a fragmentary way. Some are reminiscent of the German affinities of the tongue while others are of Latin or Greek origin. *Fox* takes the feminine *vixen;* the feminine of *wizard* is *witch,* and that of *widower* is *widow.* These and a few others are gender forms of Germanic origin; but they only constitute exceptions in the general consideration of English gender. A number of words form the feminine by the addition of -ess to the masculine. These generally indicate grammatically the feminine gender but not the masculine. In count, countess, for example, the gender of *countess* is plainly indicated by the form of the word-ending. But this is not so as regards *count,* the gender of which can be fixed only by first ascertaining the meaning of the word itself. Not only does this list of words indicate only partially the gender of the words contained therein, but it is in origin not English at all. It is extended to a comparatively small list of words, and even they are barely domesticated in the language. The same is true of the whole list of Latin and Greek gender terminations in English. They are strangers in a foreign land and their influence is negligible because they are so few in numbers, and they have not been able to put off their strange dress. This dispenses with the very few gender forms of nouns which are practically all of foreign origin and distinct from those of the older English tongue.

Gender of Pronouns.— It is a common assertion of grammarians that the personal pronouns in English afford evidence of true gender; but this is far from being the truth if gender is considered as a purely grammatical distinction. It is impossible to tell by the form of the words *I, we, you* and *they* whether the person to which they refer is male or female. It is only in the third person that something like true gender is found in *he, she, it, his, hers, its.* But the plural forms *they, their's* are devoid of gender terminations or inflections. All the other forms of personal, relative, demonstrative and possessive pronouns are similarly without true grammatical forms indicative of gender.

In older English, adjectives and certain verbal forms were declined to indicate gender, but these distinctions have now disappeared so completely that there does not survive a single exception to prove the ancient rule.

To sum up, therefore. True grammatical gender, as a general rule, does not exist in English. Not a single neuter word has a grammatical termination of English origin indicative of the fact that it represents an inanimate thing. Practically no names of male beings have distinctive grammatical inflections by which it can be at once recognized that they represent male beings. The terminations of the few feminine designations that may be said to indicate true gender in English are all of foreign origin, and their use has had practically no influence on the position of gender in the language. There is no gender evident in the pronouns in English except in the third person singular of personals and possessives, and even these forms have now become arbitrary, so that the meaning of the pronoun itself, in each case, has to be first determined before its gender can be ascertained. Adjectives, gerunds and other verbal expressions have no grammatical forms in English indicative of gender. English, therefore, in the proper grammatical sense of the term, is a genderless language.

Bibliography.— Abbott, E. A., 'A Shakespearian Grammar' (New York 1909); Alexander, C. A., 'Grammatical System of the English Language' (Boston 1796); Ash, John, 'Grammatical Institutes' (Boston 1785); Baker, J. T., 'Correct English' (Baltimore 1907); Barrett, S., 'Principles of Grammar' (Albany 1848); Brown, Goold, 'The Grammar of English Grammars' (New York 1851); Latham, R. G., 'A Handbook of the English Language' (New York 1870); Lewis, W. D., 'Practical English for High Schools' (New York 1916); Metcalf, R. C., 'English Grammar' (New York 1894); Murray, Lindley, 'English Grammar' (1795); Sweet, Henry, 'A Primer of Historical English Grammar' (Oxford 1902); Swinton, W., 'A Grammar Containing the Etymology and Syntax of the English Languages' (New York 1879).

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GENDER, a Javanese musical instrument. It consists of a row of parallel metallic plates supported horizontally by two strings passed through the respective nodal lines of the plates. Underneath each plate is an upright bamboo, containing a column of air of such a height as to reciprocate the sound of the plate above.

GENDRON, zhŏn'drŏń', **Auguste,** French painter: b. Paris 1818; d. there, 12 July 1881. He was long a pupil of Delaroche, and several times visited Italy, where he painted his first important works. In addition to several canvases, including 'The Island of Cythera'; 'Tiberius at Capri'; 'Sunday in Florence — 15th Century,' he executed frescoes in the Louvre and the church of Saint Gervais.

GENEALOGY (from the Greek *genos,* race, and *logos,* discourse), the systematic account of the origin, descent and relations of families is an auxiliary of historical science. Genealogical knowledge becomes important in a personal or legal view, when family claims are to be established. Genealogy is founded on the idea of a lineage or family. Persons descended from a common father constitute a family. Under the idea of degree is denoted the nearness or remoteness of relationship in which one person stands with respect to another. A series of several persons, descended from a common progenitor, is called a line. A line is either direct or collateral. The direct line is divided into the ascending and descending. The ascendants are called, in general, *majores* (ancestors), and the descendants *posteri* (or posterity). The collateral lines comprehend the several lines which unite in a common progenitor. They are either equal or unequal, according as the number of the degrees in the lines is the same or different. The collateral relations on the father's sire are termed *agnati,* on the mother's *cognati.* Children stand to each other in the relation either of the full blood or the half blood, according as they are descended from the same parents, or have only one parent in common.

For illustrating descent and relationship genealogical tables are constructed, the order of which depends on the end in view. In tables the object of which is to show all the individuals embraced in a family, it is usual to begin with the oldest progenitor, and to put all the persons of the male or female sex in descending, and then in collateral lines. Other tables exhibit the ancestors of a particular person in ascending lines, both on the father's and mother's side. In this way 4, 8, 16, etc., ancestors are exhibited. The tables showing the succession of rulers contain merely the descent of the persons who have reigned in succession, or who have claims to the government. In connection with them stand the tables of disputed succession, which represent several lines of a family, or several collateral families, in order to deduce their rights of succession from their degree of relationship. Synchronical tables consist of the genealogies of several families placed together, in order to compare, with facility, relationships, marriages, divisions of inheritance, etc. Historical genealogical tables differ from mere genealogical tables, as they attach to the descent the biographies also of the members. The common form of genealogical tables places the common stock at the head, and shows the degree of each descendant by lines.

The earliest genealogical tables are perpetuated in the Biblical family records of succeeding generations, in graven stone memorials of ancient Egypt, Assyria, Persia, India and other Oriental countries. Genealogical knowledge was most important in the Middle Ages, when the nobility was distinct from the other classes. Ancestors were unblushingly and imprudently fabricated, the absence of criticism and the desire to flatter important people causing the introduction of the most absurd fables into genealogy, especially after the 14th century. Few families, no matter however distinguished and noble, can trace their ancestry beyond or even as far as the middle of the 11th century. The advance of civilization and particularly the institution of corporations and guilds in the towns of the principal European nations afforded a wider scope for genealogy, and in the 12th and 13th centuries family names began to be more common. The oldest trace of family names according to Gatterer is in 1062 when a Henricus de Sinna is mentioned in Schannat's «Buchonia Veteri.» After history in general had attained a more systematic character, the Germans in particular treated genealogy on a more scientific basis. Ruxner's 'Turnierbuch' (1527) and Reusner and Hennings' genealogical tables which appeared about the end of the 16th century, are among the earliest published works, but are not conceived in an historical spirit. Duchesne, Saint Marthe, Hozier, Chifflet, Lancelot le Blond, etc., in France, and Dugdale in England, initiated a clearer and more accurate treatment of the subject. The first genealogists in Germany to base the science on documentary evidence were Rittershusius of Altdorf (d. 1670) and Spencer of Wittenberg (d. 1730). The lines laid down by them were followed and carried to higher perfection by König, Von Imhof, and especially by Hübner in his 'Genealogische Tabellen' (4 vols., 1725–33; new ed., 1737–66), to which Lentz added 'Erläuterungen' (Elucidations, 1756), and Sophia, queen of Denmark, 'Supplement-Tafeln' (1822–24). Gatterer founded the scientific treatment of the subject in his 'Abriss der Genealogie' (1788), and was followed by Pütter in his 'Tabulæ Genealogicæ' (1798), by Koch in his 'Tables Généalogiques' (1808), Voigtel (1810), Hopf (1861), Von Behr (1870), Cohn (1871), and Oertel (1871), all in Germany.

The principal genealogical MSS. sources in Great Britain are the public records, heraldic registers and the parish registers of births, marriages and deaths. The chief printed collections of genealogical information are the well-known Burke, Debrett, and other like publications of «Peerages, Baronages, Baronetages and County Histories.»

In the United States, genealogy was generally neglected until the latter part of the 19th century, when the organization of patriotic, State and colonial societies, like the Society of the Cincinnati, the Holland Society of New York, the Southern Society, etc., aroused an interest in genealogy. Genealogical societies have been organized in several States and the subject has received more or less attention. New York society folks in 1901–02 began to take up genealogy as a special fad or hobby and numbers of persons adopted the study of family trees as a regular employment. The principal publications in the United States on genealogy are 'The New England Historical and Genealogical Register'; 'The New York Genealogical and Biographical Record'; *The Heraldic Journal;* the various biographical dictionaries and cyclopædias; the printed transactions and archives of State and city historical societies; county, State, city and town histories.

GENÉE, zhĕ-nā', **Adeline,** Danish ballet dancer: b. Aarhuus, Jutland, 1878. In 1886 she made her first public appearance and in 1895 became first dancer at the Royal Opera House, Copenhagen. She appeared subsequently in Berlin and Munich and in 1897 was engaged for 10 years at the Empire Theatre, Leicester Square, London. There she appeared with great success in all the ballets brought out under the management of the Empire. In 1908 she appeared in New York in 'The Soul Kiss' and toured the United States and Canada in that ballet. She returned in 1909, 1910 and 1912. In 1911 she appeared in London and in 1913 toured Australia.

GENEE, Richard, German composer: b. Danzig 1823; d. Baden 1895. At first he studied medicine but soon abandoned it for music and went to Berlin where he studied under Stahlknecht. He became a successful orchestra leader, successively at Riga, Reval, Cologne, Aix, Danzig, Düsseldorf, Mainz, Schwerin, Amsterdam, Prague and Vienna. He composed several operettas, which were highly successful. They include 'Der Geiger von Tirol' (1887); 'Der Musikfeind,' 'Die Generalprobe' (1868); 'Rosina' (1868); 'Der Seekadett' (1876); 'Der schwarze Prinz' (1887); 'Im Wunderlande der Pyramiden'; (1887); 'Die letzten Mohikaner' (1887); 'Die

Piraten' (1887); 'Nisida' (1887); 'Die Dreizehn' (1887).

GENEE, zhē-nā, **Rudolf,** German author: b. Berlin, Prussia, 12 Dec. 1824; d. Berlin, 19 Jan. 1914. He abandoned wood engraving for journalism and then became an instructor in literature at Berlin. As a reader and interpreter of Shakespeare he attained distinction; but his plays — 'The Prodigy' (1854); 'A New Timon'; 'In Front of the Cannon'; 'The Hermitess'; and adaptations from Sheridan — gave him wider fame. His works in criticism, treating of German poetry, the drama and kindred themes, are highly esteemed. 'Marienburg' is a historical novel that passed two editions, and his 'Bismarckiade' is an addition to German history.

GENELLI, gā-nĕl'lē, **Bonaventura,** German painter: b. Berlin, 28 Sept. 1798; d. 13 Nov. 1868. He was the son of Janus Genelli (1771–1812), an engraver, with whom he early studied. His chief artistic training was obtained as a pupil of Johann Erdmann Hummel at Berlin and at Rome, where he resided in 1822–32, and executed numerous pencil and india-ink drawings which carried his name over much of the Continent. From 1836 he was in Munich, often in poverty; for he received no public commissions and his work had as yet met its due recognition among but a few. In 1859 he was called by Grand Duke Charles Alexander to Weimar, where ample leisure was afforded him for his larger works in oil. He was a classicist like Carstens, whose methods he followed, and with him the chief thing was the rendering of line. Among his many works are the series of drawings for Dante's 'Divine Comedy,' and for Homer; other drawings in ink or water-colors, such as 'Hercules Playing the Lyre'; The 'Vision of Ezekiel,' and 'Æsop Telling His Fables,' and the pictures in oil: 'Abraham and the Angels'; 'The Battle of Lycurgus with Bacchus'; 'Bacchus among the Muses.' There is a biography of Genelli by Jordan (1869). Consult also Muther, History of Modern Painting' (1907).

GENERAL, (1) A military rank and title. In the United States army, this rank, as distinguished from and superior to the major-general, was created for Washington by Congress, 3 March 1799. He died shortly after, the office remained vacant, and in 1802 it was abolished. It was revived in 1866 for U. S. Grant, and on his accession to the Presidency in 1869 was conferred on William T. Sherman. On his retirement, 1 Nov. 1883, the rank was allowed to lapse. In June 1888 it was revived for Philip H. Sheridan, and on 6 Oct. 1917 for John Joseph Pershing (q.v.). The address of general is commonly accorded to lieutenant-generals, major-generals and brigadier-generals. Over 200 generals of the different grades are on the retired list of the United States army. The highest army officer has now the title of chief of staff. (See GENERAL STAFF CORPS). The French have brigade-generals and division-generals. The Germans and Russians classify their generals as "of artillery," "of cavalry," and "of infantry."

(2) The name given to the general superior of religious orders and congregations of men in the Roman Catholic Church. The general is usually elected in general chapter and holds office for three years. In the Society of Jesus the general is elected for life. The generals of regular orders have been granted by popes special privileges, as power of absolution in reserved cases in relation to their subjects. Several modern congregations of women have general superiors, but their canonical position is quite different from that of the general of the orders of men.

(3) A term added to various civil titles, as postmaster-general, attorney-general, indicating a broad authority in the office held. Compare ADMIRAL.

GENERAL ASSEMBLY. See ASSEMBLY, GENERAL; PRESBYTERIANS.

GENERAL AVERAGE. See LAW, MARITIME.

GENERAL BAPTISTS. See BAPTISTS.

GENERAL CONFERENCE MENNONITES. See MENNONITES.

GENERAL CONFERENCE OF THE METHODIST EPISCOPAL CHURCH. The Methodist Episcopal Church is one of the most highly organized bodies in the world. Its organization is an evolution produced by the ever-growing needs of the Church and the times. Its episcopacy was gradual in its growth. The General Conference has come to be what it is now by a slowly developing process.

Development.— When Francis Asbury first arrived in this country in 1771 there were only nine preachers in the whole Church, so there was no necessity for a General Conference. Later, when the work was extended and the men were widely scattered, the preachers met annually in groups. Thus the Annual Conferences came to be formed. In order to have uniformity of discipline and coherence in the whole body, a General Conference became a necessity. In 1784 the Christmas Conference, as it is called, met at Baltimore. Its gathering marks the specific organization of the Church as a separate ecclesiastical body. Among the items of business of its session was the ordination of Thomas Coke and Francis Asbury as general superintendents. Francis Asbury had for some years been exercising nearly all the prerogatives of a bishop of the Church. They were the choice of John Wesley, but would not consent to ordination until confirmed by the franchises of those present. Nearly 60 of the total of 81 preachers were present and voted unanimously for the ordination. The second General Conference met in 1792 and thereafter quadrennially. The first General Conferences were not delegated bodies, all ministers in full connection had the right to attend. In 1800 a restriction was made that eligibility required membership in a Conference for four years. The first delegated Conference met in 1812 and consisted of 90 members. In 1872 the laymen were introduced, two from each Conference. The first woman delegates appeared in 1888. The final step in giving laymen their rights was taken in 1900, when the number of clerical and lay delegates was made equal. In 1812 the ratio of representation was made 1 delegate to each 5 ministers; in 1816, 1 to 7; 1836, 1 to 25; 1856, 1 to 27; 1860, 1 to 30; 1872, 1 to 45. The Conference of 1864 declared that each Conference, no matter how small, is entitled to one delegate. Now each Conference is entitled to one clerical and one lay delegate for each 45 members. If the fraction of three-fourths of 45 should remain, the Conference is entitled to another delegate. The General Conference of 1796 met in November, but beginning with 1800 the Conference has always met in the month of May. A special session has never been called by the bishops or a majority of them. The ministerial and lay delegates vote together unless a third of either the clerical or lay delegates demand a separate vote. The place of meeting is selected by the committee of arrangements appointed at the previous General Conference. It is the sole law-making body of the Church. The Annual Conference is an administrative body only.

Delegates, how Elected.— The ministerial delegates are elected by ballot by the Annual Conference in the session just previous to the meeting of the General Conference. They also elect reserve delegates. The election of the lay delegates is more complicated. At a meeting of the congregation of a local church all members over 21 years of age elect a delegate to the lay electoral Conference, which meets during conference week at the same place as the Annual Conference. These delegates from the local churches elect from their number the proper number of delegates to the General Conference. They also elect two or three reserve delegates who serve in the place of deceased or absent members of the delegation.

Organization.— The organization of the Conference is highly efficient. The presiding officer is always a member of the board of bishops. In case, however, that all the bishops should be absent, the Conference would elect a president pro tem. The bishops preside in the order of seniority of election. The secretary is elected by the body and chooses quite a large staff of assistants. The great bulk of the work is done by committees, who debate all questions referred to them and bring their conclusions to the main body, which accepts or rejects the findings of the committee. First of all is the committee of reference, composed of five persons — two ministers, two laymen and the secretary of the Conference. There are 16 general committees to which reference is made. Thirteen of the committees include one clerical and one lay delegate from each Conference as members. The following are the "standing committees," as they are called: (1) Episcopacy; (2) Judiciary, consisting of 19 members, usually men of a legal turn of mind, and including several lawyers from the lay delegates; (3) Itinerancy; (4) Boundaries; (5) Revision — 19 members; (6) Temporal Economy; (7) State of the Church; (8) Book Concern; (9) Foreign Missions; (10) Home Missions and Church Extension; (11) Education; (12) Freedmen; (13) Sunday Schools; (14) Epworth League; (15) Deaconess Work — 39 members; (16) Temperance, Prohibition and Public Morals. The committees do not have the power to originate business, only to pass upon that referred to them. Other special committees are appointed as needed. Usually the delegates vote together, but the clerical and lay delegates may vote separately when one-third of the delegates of either order request it.

Powers.—(1) The Conference elects the bishops and decides where they shall reside for the ensuing quadrennium. It also, through the Committee on Episcopacy, reviews their work for the previous four years. The Conference may accept the resignation of a bishop, retire or depose him. Twice have bishops in active service resigned — Bishop L. L. Hamline and Missionary Bishop W. F. Oldham, later elected bishop. Wilbur Fisk was elected bishop but declined to serve. Joshua Soule was elected and refused ordination, but was later re-elected. James R. Day was elected but immediately resigned before ordination. Never has there been a retirement or deposition for moral cause. A bishop "at the close of the General Conference nearest his 73d birthday shall be released from the obligation to travel through the Connection at large, and from residential supervision." The same is true of a missionary bishop.

(2) The Conference elects the editors of all official publications of the Church, including the editor of Sunday School publications, and the editor of *The Epworth Herald* and *The Methodist Review*. It also elects the secretaries and managers of the various benevolent and executive boards, the agents of the Book Concern, the Book Committee and the trustees of the Methodist Episcopal Church.

(3) It may repeal any laws made by previous General Conferences, except the "restrictive rules."

(4) It may enact any laws it may see fit. In case of constitutional changes or amendments they must be submitted to the Annual Conferences and the Lay Electoral Conferences for an expression of opinion. A two-thirds vote of all members present and voting in all the Annual Conferences and Lay Electoral Conferences suffices to authorize the next General Conference to alter or amend by a two-thirds vote any provisions of the constitution except the "restrictive rules."

(5) The bishops are the official interpreters of the law of the Church, but the General Conference may give a contrary interpretation through its judiciary committee, binding the bishops to another method of procedure.

(6) The General Conference is a final court of appeal for minister, bishop, layman, Church or Annual Conference.

(7) It determines the boundaries of the Annual Conferences.

(8) It receives fraternal delegates from other Churches and hears their messages.

(9) It receives the reports from the various benevolent and executive boards and disposes of them.

(10) Through its various commissions authorized, it carries on its work through the quadrennium. The members of the commissions are appointed by the bishops.

Restrictions of Powers.— The restrictions of the powers of the General Conference are embodied in the "restrictive rules" and are six in number. They are:

(1) "The General Conference shall not revoke, alter, nor change our Articles of Religion, nor establish any new standard or rules of doctrine contrary to our present existing and established standards of doctrine."

(2) "The General Conference shall not

organize, nor authorize the organization of an Annual Conference with less than 25 members.»

(3) «The General Conference shall not change nor alter any part or rule of our government so as to do away with Episcopacy, nor destroy the plan of our itinerant General Superintendency, but may elect a Missionary Bishop, or superintendent for any of our foreign missions, limiting his episcopal jurisdiction to the same respectively.»

(4) «The General Conference shall not revoke nor change the General Rules of our Church.»

(5) «The General Conference shall not deprive our ministers of the right of trial by the Annual Conference, or by a select number thereof, nor of an appeal; nor shall it deprive our members of the right of trial by a committee of members of our Church, nor of an appeal.»

(6) «The General Conference shall not appropriate the produce of the Book Concern, nor of the Chartered Fund, to any purpose other than for the benefit of the traveling supernumerary and superannuated preachers, their wives, widows and children.»

Methods of Business.— The order and conduct of all business of the Conference is governed by 58 rules. The sessions of the General Conference are almost entirely held in the forenoon. The committees meet in the afternoon. Soon after the Conference has convened the bishops present, through one of their number, read their Quadrennial Message. This custom originated with Bishop McKendree, who presented his message to the General Conference of 1816. It then goes to the committee on reference which distributes its parts to the proper committees. The presentation of this «address» is the only active part the bishops may have in the Conference, beside the function of presiding. They may not enter into a debate, nor vote. They can only address the Conference as a matter of privilege. Next the roll of Annual Conference delegations is called, and petitions and memorials are presented by the delegation when called without debate. They include memorials from individuals, churches and Conferences. After the committee to which a memorial is referred has its discussion and formulates its report, it is published in the *Daily Christian Advocate*, and after laying over a day or more is acted upon after such debate as the Conference may see fit. Then the question is closed, the vote taken and the majority decides the question. More than one call for memorials is made. Resolutions for immediate passages are often presented and passed. Sometimes when the report of a committee involves a change, the report is referred to the committee on judiciary, asking for an opinion as to its constitutionality, or if it conflicts in any way with civil law.

Publications.— In addition to the *Daily Christian Advocate* published during the session of the Conference, the secretaries publish, after the Conference adjourns, 'The Journal of the General Conference,' which contains all acts and other papers in full. It also contains all proceedings but none of the debates; these are found only in the *Daily Christian Advocate*. They also publish 'The Doctrines and Discipline of the Methodist Episcopal Church,' which contains all the Church law for clergy and laity, addresses of Church officers, and the Conference Course of Study for students for the ministry. Consult Sherman, D., 'History of the Discipline' (3d ed., New York 1890); Merrill, Stephen M., 'Digest of Methodist Law' (revised by David G. Downey, New York 1912); Neeley, T. B., 'History of the Origin and Development of the Governing Conference of Methodism' (Cincinnati 1892); Buckley, J. M., 'The Constitution and Parliamentary History of the M. E. Church' (New York 1912).

The General Conference of the Methodist Episcopal Church South has almost identical powers, restrictions and methods of business. The ratio of representation is 1 to 48, and one of the lay delegates from an Annual Conference may be a local preacher. A further difference lies in that the bishops may veto a constitutional change after it has passed by a two-thirds vote of the General Conference and three-fourths of the members of all the Annual Conferences, if in their judgment it is unconstitutional. The Methodist Protestant Church, not having an episcopal form of government, elects its presiding officer by ballot. Their ratio of representation is one minister and one layman for each 2,000 persons in full membership. Two-thirds of the whole number of the Annual Conferences have power to call special sessions of the General Conference. Ministers and laymen may vote separately if a call is made by five persons.

The Free Methodist Church includes the bishops as members of the General Conference. Their ratio of representation is one layman and one clergyman, and when the aggregate membership of an Annual Conference reaches 800 members in full relation it is entitled to two additional delegates for every subsequent 600 members in full relation within the Conference. They have three «restrictive rules.» Among other things mentioned by other churches as prohibited from being changed by the General Conference is «the free-seat system of our churches.» The will of the General Conference is carried out by a bishop, a minister, and a layman from each General Conference district, known as the executive committee. There are 6 General Conference districts in the Free Methodist Church. There are 15 in the Methodist Episcopal Church. The powers of the executive committee include the filling of all vacancies in General Conference offices, and the supervision of the publishing interests of the Church.

The United Brethren in Christ have a General Conference which has similar powers and restrictions to the other churches mentioned.

The African Methodist Episcopal Church is organized after the fashion of the Methodist Episcopal Church. The same may be said of the African Methodist Episcopal Zion Church, and the Colored Methodist Episcopal churches.

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GENERAL COURT, the name of the legislative assemblies of Massachusetts and New Hampshire during colonial times, and subsequently applied to their State legislatures. The old English name of the meeting of a body of managers or members of any corporation is «court»; as court of aldermen, court of directors, etc. So the meeting of corporators of the old Massachusetts Company was called a court; then the primary assembly of freemen under its charter was called the General Court; and the name was retained after it became a representative body. There was the further reason that it really was the supreme judicial as well as legislative body. See MASSACHUSETTS.

GENERAL EDUCATION BOARD, an organization chartered by Congress in 1903, primarily to enable John D. Rockefeller to distribute his gifts and aids to education, and secondarily to make it possible for other men of means to promote the advancement of education in the United States in a more effective and systematic manner than had heretofore been possible. The sphere of the General Education Board embraces the promotion of practical farming and of public high schools in the Southern States; of negro education and institutions of higher education everywhere throughout the United States. Under an agreement entered into with the United States Department of Agriculture in 1906 the General Education Board contributed $405,700 for the promotion of practical farming within the province of the charter of the organization. This was employed in promoting demonstration farms and the furnishing of instructors for the education of farmers. The work of the Board also influenced the practical teaching of agriculture in the schools of the South. In the promotion of public high schools in the Southern States the Board appropriates for the use of each State Department of Education or State University the funds necessary to pay the salary and traveling expenses of a special high school representative whose business it is to stir up public sentiment in favor of public high schools, and to organize the different sections where he is at work so as to promote the end in view. The Board has already devoted large sums of money to this department of its work; and the high school representatives paid by it have raised several millions of dollars for the establishment of public high schools in the South. So effective was this part of the work that by 1911 over 700 new high schools had been opened through direct work of the Board. On the same date the General Education Board had already appropriated over $25,000,000 as gifts to encourage institutions of higher learning made to some 82 colleges and universities in the United States and for other educational ends. Of this sum $2,300,000 went to colleges in the Southern States; $2,510,000 to those of the Western States; $1,805,000 to those in the Middle and Eastern States. About half a million dollars had also been devoted by the Board for the promotion of negro education.

The work of the General Education Board has both a practical and a social side. Over 200,000 farmers are being influenced for the betterment of agriculture by its exertions, while State agents paid by the Board have for some time been conducting demonstration work among boys under actual farming conditions, and by the establishment of «corn» and other clubs. Other clubs of a social nature have been organized for the promotion of more social life in farming communities; while educative clubs to study house management, poultry, preservation of fruit and other subjects directly related with agricultural life have also been encouraged in various ways, more especially in connection with the girl's clubs.

Since 1911 the work of encouraging the establishment of public high schools in the United States has progressed rapidly, carried along by its own momentum and the ceaseless work of the educational representatives of the Board. But the same may be said of the work of the Board in all the departments of its self-imposed activities.

GENERAL GRANT NATIONAL PARK, California, located in Tulare and Fresno counties; usually mentioned in connection with Sequoia National Park (q.v.) because, though separated by six miles of mountain and forest, the two are practically the same governmental reservation. The area of the former, the subject of this paragraph, is 2,536 acres and its altitude ranges from 5,250 feet to 7,631 feet. Created primarily (by act of 1 Oct. 1890) for the protection of the General Grant tree, a very beautiful *Sequoia Washingtoniana,* 264 feet high and 35 feet in diameter at the base, the park has made such substantial progress that its superintendent in 1915 mentioned in his report the hotels, stores, feed-yards, post offices, telephone stations and photograph galleries within his jurisdiction. It is situated on the western slope of the Sierra Nevada 46 miles from Sanger. Between that station (on the Southern Pacific Railroad) and the park regular transportation service has been established. The number of visitors was 7,022 in 1915 (1 April to 10 August), of whom 5,019 arrived in automobiles. Mammals native to the parks are the elk, deer, mountain sheep, squirrels, flying squirrels, porcupine, hares, rabbits, bear, wolves, foxes, mountain lion, lynx, ring-tailed cat, raccoon, wolverine, etc. The Sequoia and General Grant parks are homes of both migratory and breeding birds. Owing to the topography of the parks and their varied climatic conditions, birds of both the torrid and frigid zones come to them. There is a constant movement of the birds north and south and from the high mountains to the lower and from the lowlands to the higher elevations; in all, 194 species have been observed, including plover, grouse, partridges, pheasants, wild turkey, hawks and eagles. The best season for tourists is between the middle of June and October, when the atmosphere is usually cool and clear. The main tourist camp ground in General Grant National Park consists of 35 acres fenced with steel woven wire attached to cedar posts. A description of the forests with their «big trees» is given in the article SEQUOIA NATIONAL PARK. See also NATIONAL PARKS AND MONUMENTS.

GENERAL HOSPITAL. See HOSPITALS, MILITARY.

GENERAL ISSUE, in English law, is a plea denying the whole declaration or indictment, without offering any special matter by which to evade it. It is called the general issue, because, by importing an absolute denial of what is alleged in the declaration, it amounts at once to an issue, or fact affirmed on one side, and denied on the other. This is the ordinary plea upon which most causes are tried, and is now almost invariably used in all criminal cases, when the prisoner at the bar pleads «not guilty.» To money counts the plea is «never indebted»; or to actions on simple contract *nunquam assumpsit* («never undertaken»). This plea puts everything in issue, that is, denies everything, and requires the party to prove all that he has stated. It is a frequent question, What can be given in evidence by the defendant upon this plea? and the difficulty is, to know when the matter of defense may be urged upon the general issue, or must be specially pleaded upon the record. See PLEA AND PLEADING.

GENERAL PARESIS (known also as general paralysis, softening of the brain, paralytic dementia, general paralysis of the insane, etc.), a disease of the nervous system that usually begins in early adult life, progresses steadily with increasing mental enfeeblement, and leads to ultimate motor paralysis, decay of all of the mental faculties and death within a period averaging from three to five years. From the type indicated in this brief general definition there are numberless variations. It is a disease which, when well advanced, is recognized with great ease, but in its early stages it may be extremely difficult to know. From the standpoint of the patient's family and friends it is important to be able to recognize the disease; for it is in this initial period that the patient often ruins his business, his friends, his family and brings shame and discomfort to all those connected with him. Much of this might be averted if the layman were better informed of this early period of one of the worst scourges of modern times. The disease has probably existed for many centuries, but it is only within comparatively recent times that its true character has been recognized, and in its present extreme forms it seems to be a product of the modern complex social system. It has been aptly termed a disease of civilization and *syphilization*, an alliteration that contains much truth. Syphilis is the sole cause of general paresis. The disease is a parenchymatous syphilitic disease of the brain, a special trend taken in the development of brain syphilis. (See article on BRAIN SYPHILIS). Before the *Treponema pallida*, the name given to the minute parasitic organism which is the cause of syphilis, had been found in the brain tissues of paretics, the statistical study of the disease had proved its syphilitic origin for about 90 per cent of the cases, but with the advances made by medicine in refined methods of diagnosis, the dictum, no syphilis, no general paresis, has come to have universal recognition. There are forms of pseudo-paresis which in their clinical appearances may resemble paresis, but a study of the blood and of the cerebro-spinal fluid, which should be done in all suspected cases, will establish the correct diagnosis. Among the disorders which may resemble paresis are brain tumor, poisoning by mercury or lead and by alcohol. Certain senile softenings of arteriosclerotic origin may resemble paresis. Certain maniacal trends in manic depression psychoses often are confused with the early maniacal phases of paresis. Bromide poisoning sometimes resembles paresis. General paresis is commoner in men than in women, the proportion among different peoples and races, and times, varying from 25–1 to 3–1. Although it is a disease usually beginning in the 30's or 40's, juvenile forms are known, and sometimes the old man is a victim. It seems to be more prevalent in crowded communities, for there the stress of excitement and depression, of gaiety and sadness, of extravagance and destitution, is more pronounced, for both extremes of the mental pendulum must be considered in the estimation of the strain on a syphilitic brain. The brilliant financier, or the actress who succumbs to this disease may be more in the public eye, and moralists may adorn a tale concerning their supposed profligacy, but the poor, harassed workman, diseased through lack of knowledge, and drink-sodden to escape the reproofs of his conscience, may also be the victim.

The initial symptoms are usually very insidious, although occasionally the disease appears in full-blown vigor. The previously healthy, neat and careful workman begins to forget things. There is a period of disturbed mentality. Noises affect him unpleasantly. Undue irritability is evidenced by unwonted explosions of anger. This state may be weeks or months in its evolution, and may be confounded with a condition of overwork or overworry. In fact, such a condition is present in many tired people who never develop paresis. Added to this there are vague apprehensions in the patient's own mind of his gradually declining power; headaches, neuralgias, and vague pains may also be present; and poor sleep may be another symptom of the early stage. All of these symptoms are common to many people who have overworked, and should not occasion alarm. But when, little by little, one shows increasing carelessness in his personal habits, such as neglecting to button his trousers, or permitting his food to spill on his clothing, when he shows signs of mental exaltation and dreams of wonderful things, then the true disease begins to show itself. From this point on there are countless variations, but in general the typical paretic behavior that leads the person into economic danger, if not disaster, is characterized by an expansive and exaggerated conduct. Buoyancy and elation with great projects and sanguine hopes mark the initial stages of the paretic's mental decay. He becomes restlessly busy, is continually entering into new schemes, is incessantly talking about his affairs with effusive geniality, not only to his friends, but to utter strangers, and he even communicates to others his closest domestic concerns. There is a gradual breaking down of the finest sensibilities and, closely following this, slight evidences of the loss of the most delicate motor adjustments become manifest. It is in this stage that the symptoms become unmistakable. The partial impairment of the motor functions shows itself in an increased lack of control of the finer motions of the tongue, the lips and the hands. There is a fine tremor in the tongue when it is protruded; on showing the teeth, the angles of the mouth betray a fine tremor; and the handwriting is seen to be less firm and even, approaching that of the formative period of the man's youth. The mild grade of inflammation in the brain causes certain changes in the reflexes of the body. Thus the pupils of the eyes are not apt to act as rapidly as in health; they may be unequal in size; they are sometimes very small and do not open wide in the dark as is usual. With these symptoms the diagnosis becomes moderately certain, and from this time on the mental degeneration becomes marked. The carelessness becomes slovenliness; the memory goes rapidly; the loss of the finer sensibilities deepens to obscenity, to faithlessness, to utter loss of the moral faculties; the buoyancy becomes foolishness, and big projects are often launched, resulting in financial ruin. Grandiose ideas usually enlarge, and the afflicted one dreams of millions of money, of being a king or president, or Christ, or a god. His personal strength is like that of Samson, his beauty comparable to Apollo's; his voice, his oratory, his writing, his poetry, his acting are superb — in short, his whole personality is puffed up with an amazing exaltation of the ego. Exulting self-confidence dominates all his designs, and a restless, busy, subdued delirium actuates his every thought and movement. From this stage, usually termed the grandiose stage, and which may persist for from six months to a year or more, the mental deterioration commences to show itself in a gradually progressive dementia. Mental dilapidation becomes mental decay. The motor restlessness goes on to loss of power and a gradual paralysis of the motor functions begins, passing through the stages of progressively increasing inco-ordination to complete powerlessness. Tottering, shambling, stumbling incompetence finally advances to absolute motor impotence. This affects all of the muscles of the body, but is appreciated in the speech more readily and earlier than in other motor acts. The loss of ability to repeat the r's and l's, as in «truly rural,» «artillery,» etc., is an early sign of this speech-defect. Finally the only answer that can be obtained from the patient is that he is «all right.» The lack of motor power further manifests itself in the increasingly diminished control of handwriting. The paretic is unable to keep to a line. His writing goes up and down, letters and words are omitted, the up strokes are very wavy and the letters become unequal in size.

Thus the course of the disease progresses until, in from two to three years, on the average, the paretic is a bedridden dement, who dies of exhaustion or an apoplectic or epileptiform convulsion. Occasionally remissions of the disease occur. These are particularly trying to most of the paretic's friends, for hopes of recovery receive a sudden stimulus only to be destroyed after a period of from six months to a year or so. Occasionally the remissions last a number of years, but at the present time it is believed that general paresis is a necessarily fatal disease.

The main features of a central type of the disease are here given, but there are countless variations. Acute maniacal states sometimes occur, and the patient dies in a galloping frenzy in from three to six months. Occasionally a paretic is melancholic or stuporous throughout. A small proportion, one-half per cent of the cases, show this type. Occasionally — and many modern alienists believe this to be more common at present — a gradually progressive dementia without grandiose ideas marks the entire course of the disease. Most cases of paresis have apoplectiform or epileptiform attacks at some period of the disease. A few begin in this manner. There are countless numbers of mixed forms, the details of which may be consulted in textbooks of mental disease. Here also the subdivisions of the disease into stages may be found. Of the treatment little may be added. The most essential step in relation to this disease is its early recognition. To be able to know what is the matter before the patient has ruined his business, or his family and friends, is the most important feature for the layman to grasp. The paretic himself is doomed, but it is not necessary for those dependent on him to suffer irretrievable loss because of his disease. The proper course to pursue is to place the patient in a sanatorium or asylum at the earliest possible moment, the place selected depending largely on the means of his friends or relatives. Consult Maudsley, 'Pathology of Mind' (1895); Chase, 'General Paresis' (1902); Kraepelin, 'General Paresis, Nervous and Mental Disease Monograph Series' (the best short discussion in English); Jelliffe and White, 'Diseases of the Nervous System' (2d ed., 1917). See DEMENTIA; INSANITY.

SMITH ELY JELLIFFE, M.D.

GENERAL PAUSE, in music, a pause for all instruments, or a pause for parts in a composition. It is often employed with striking effect, when so introduced as to break the rhythm. To render its length indeterminate a «hold» 𝄐 is placed over it.

GENERAL SESSIONS, Court of. See COURT.

GENERAL STAFF CORPS. The General Staff Corps of the United States Army, created in conformity to the act of Congress in 1903, is composed of the grades and number specified in said act, detailed for service in said corps for a period of four years unless sooner relieved, under rules of selection prescribed by the President. Upon being relieved from duty in the General Staff Corps officers return to the branch of the army in which they hold permanent commissions and except in case of emergency or in time of war are not eligible to further detail therein until they have served for two years with the branch of the army in which commissioned. This ineligibility does not apply to any officer who has been relieved prior to the expiration of four years' duty with the corps; but such officer becomes ineligible as soon as he shall have completed a total of four years of said duty. While serving in the General Staff Corps officers may be temporarily assigned to duty with any branch of the army. The law establishes the General Staff Corps as a separate and distinct staff organization, the chief of which has supervision, under superior authority, over all branches of the military service, line and staff, except such as are exempted therefrom by law or regulations, with a view to their co-ordination and harmonious co-operation in the execution of authorized military policies.

The General Staff Corps, under the direction of the Chief of Staff, is charged with the duty of investigating and reporting upon all questions affecting the efficiency of the army and its state of preparation for military operations, and to this end considers and reports upon all questions relating to organization, distribution, equipment, armament and training of the military forces (regulars, volunteers and militia), proposed legislative enactments and general and special regulations affecting the army, transportation, communications, quarters and supplies; prepares projects for manœuvres; revises estimates for appropriations for the support of the army and advises as to disbursement of such appropriations; exercises supervision over inspections, military education and instruction, examinations for the appointment and promotion of officers, efficiency records, details and assignments and all orders and instructions originating in the course of administration in any branch of the service which has relation to the efficiency of the military forces; prepares important orders and correspondence embodying the orders and instructions of the President and Secretary of War to the army; reviews the reports of examining and retiring boards and acts upon such other matters as the Secretary of War may determine.

The General Staff Corps under like direction is further charged with the duty of preparing plans for the national defense and for the mobilization of the military forces (including the assignment to armies, corps, divisions and other headquarters of the necessary quota of general staff and other staff officers), and incident thereto with the study of possible theatres of war and of strategic questions in general; with the collection of military information of foreign countries and of our own; the preparation of plans of campaign, of reports of campaigns, battles, engagements and expeditions and of technical histories of military operations of the United States. To officers of the General Staff Corps are committed the further duties of rendering professional aid and assistance to the Secretary of War and to general officers and other superior commanders and of acting as their agents in informing, and co-ordinating the action of, all the different officers who are subject under the provisions of law to the supervision of the Chief of Staff. They perform such other military duties not otherwise assigned by law as may from time to time be prescribed by the President.

Officers of the General Staff Corps assigned to duty with commanders of armies, divisions, separate brigades and territorial departments are collectively denominated the General Staff serving with troops. They serve under the immediate orders of such commanders; those not so assigned perform duty under the immediate direction of the Chief of Staff and constitute the War Department General Staff. To facilitate the performance of its duties this latter is arranged in sections, each under the direction of an officer of the General Staff Corps designated by the Chief of Staff. Such committees are designated in the sections from time to time as may be necessary to facilitate the transaction of business in hand. The War Department General Staff in its several sections and committees stands in an advisory relation to the Chief of Staff in the performance of the duties herein devolved upon him. The distribution of duties to the several sections and committees is regulated by the Chief of Staff.

The command of the army of the United States rests with the constitutional commander-in-chief, the President, who places parts of the army and separate armies whenever constituted under commanders subordinate to the general command; and, in case of exigency seeming to him to require it, he may place the whole army under a single commander subordinate to him; but in time of peace and ordinary conditions the administration and control of the army are effected without any second in command. The President's command is exercised through the Secretary of War and the Chief of Staff. The Secretary of War is charged with carrying out the policies of the President in military affairs. He directly represents the President and is bound to act in conformity to the President's instructions. Under the law and the decisions of the Supreme Court his acts are the President's acts and his directions and orders are the President's directions and orders. The Chief of Staff reports to the Secretary of War, acts as his military adviser, receives from him the directions and orders given in behalf of the President and gives effect thereto. For purposes of administration the office of the Chief of Staff constitutes a supervising military bureau of the War Department.

The general staff of a command consists of general staff officers of such number and grades as may be assigned to it on the recommendation of the Chief of Staff. The senior general staff officer on duty with a command, unless otherwise directed by the War Department, is the chief of staff of the command. Ordinarily he is so assigned by the War Department. The duties of the chief of staff of a command are as prescribed for officers of the General Staff Corps, and in addition he, under direction of the commander of the troops, performs all duties analogous to those devolved upon the Chief of Staff of the army. The other general staff officers serving with troops are employed under the direction of the commanders thereof upon the duties prescribed for officers of the General Staff Corps, and they perform such other duties within the scope of general staff employment as may be directed by such commanders. General staff officers are not assigned to other than general staff duties except by special authority of the War Department. The two general officers authorized for the General Staff Corps are detailed by the President from officers of the army at large and below the grade of brigadier-general. All vacancies that may occur in the General Staff Corps in grades below that of brigadier-general are filled on the recommendation of a board of five general officers of the line, not more than two of whom shall be members of the General Staff Corps, convened by the War Department at such times as may be necessary. The board is sworn to recommend officers solely on their professional efficiency and on their probable aptitude and fitness for general staff service, and selects such number of officers of the proper grades to fill existing or expected vacancies as the War Department may direct.

EDWARD S. FARROW.

GENERAL THEOLOGICAL SEMINARY, a seminary of the Protestant Episcopal Church in the United States, established in 1817. Instruction was begun in New York city in 1819, but in 1820 the seminary was removed to New Haven. It was again re-established in New York in 1822. The gifts of Dean Hoffman to the school amounted to over $1,000,000, while in 1910 the total resources of the school were over $2,000,000. The theological course of the school extends over a period of three years, and there is a graduate course. The degrees of D.D. and B.D. are conferred. The control of the seminary is vested in a board of trustees composed of the presiding bishop of the Church; the bishop of New York; the dean of the seminary; 10 bishops chosen by the House of Bishops; 10 presbyters and 10 laymen chosen by the House of Deputies of the General Convention; and three bishops, three presbyters and three laymen chosen by the associate alumni. There are about 150 students in regular attendance.

GENERAL TICKET. See CONVENTIONS, POLITICAL; ELECTIONS; VOTE, VOTERS, VOTING; BALLOT; PRIMARY, DIRECT; PRIMARY, PRESIDENTIAL PREFERENCE; CAUCUS; CONGRESS; UNITED STATES — THE BEGINNING OF THE PARTY ORGANIZATION; and the parties by name.

GENERALIFE, hä-nä-rą-lē'fä (Arabic, Garden of the Architect), a summer palace of the Moors at Granada, Spain, near the celebrated Alhambra. The Darro flows through the grounds, which contain many splendid cypresses over 700 years old. There are a raised garden and belvedere. The palace and grounds are the property of the Marquis of Campotejar.

GENERATION, popularly used as a measure of time, and usually represents about 30 years, the period which man requires to attain maturity, and the age at which, as a general rule, the first child is born. This secondary sense of the term is thus indirectly derived from the primitive meaning, which has reference to the origin of living things. In the higher animals and plants the offspring is due to the congress of distinct individuals or elements. (See REPRODUCTION). Alongside of this process, sometimes even concurrently with it, new forms may arise by fission, or by budding; by a process akin to the latter, as in the parthenogenesis of bees, etc.; or by a combination of the sexual and asexual processes, alternate generation.

GENERATION, Spontaneous. See SPONTANEOUS GENERATION.

GENERATIVE CELL, the cell which divides its stalk and body cells in gymnosperms; the cell formed by the first division of the nucleus of the pollen grain in the angiosperms. See SPERMATOPHYTE.

GENERATORS. Generators are machines which are used to transform mechanical energy into electrical energy. Where the electrical machines are used to convert electrical energy into mechanical energy they are termed motors. If we simply desire to raise the voltage or pressure of the source of supply to a higher value, such as in long-distance electric power transmission, we use a stationary device with two separate windings of a definite ratio of terns of wire which is called a transformer. If we choose simply to change from one form of electrical supply such as alternating currents to another form such as direct currents we use a machine with a rotating element known as a rotary converter, the alternating current passing in one side, the direct currents leaving from the other side. The rotary converter is really a direct current generator and an alternating current motor combined in one apparatus. When an alternating current is converted into a pulsating direct current we may use a stationary device consisting of a glass sealed container having a vacuum, containing mercury with several terminals known as a mercury arc rectifier. For further explanation as to the principles involved in these devices the reader is referred to articles on ELECTRICITY and ELECTRIC DIRECT CURRENT.

The general method of using electrical generators is to locate the power-house either near some natural source of energy such as a water fall or near the centre of distribution of some large city, preferably near a river or lake where adjacent water may be used for cooling the condenser of the steam-engines. Starting with 1878 with the patenting of the first incandescent lamp by Thomas Edison the development of small electrical generators became rapid, the general plan being to drive the electrical generator with a steam-engine. Where water power is plentiful it is used in preference to steam. In using water power it should be understood that while the expense for coal is eliminated still there is a larger initial investment for pipe-lines, dams, reservoirs, etc., necessary, the interest on which capital forms a large yearly expense. In many places where water power generators have been installed, due to fluctuations in the water supply, it has been necessary to reinforce them with steam-driven generators.

In the early days of commercial electrical development electric generators were only of a small size consisting of a few horse power. Generators are rated in kilowatts, a kilowatt being 1,000 watts, 746 watts equalling one horse power. The size grew rapidly until at the present day we have turbine-driven generators of 50,000 horse power operating in some of our large central stations.

Thomas Edison developed the direct-current system of electrical generators and distribution. Due to the large loss in energy in the form of heat by the electric current passing through the wires it became necessary in the early days to build a new power-house every few miles. At one time New York City contained a large number of small power-houses containing generators which supplied power to the subscribers in their immediate territory. Due to these limitations electric power development, especially for electric lighting, would have been extremely limited in its application were it not for Nikola Tesla's developing and patenting the alternating current system of distribution. Tesla's patents covered the generator, transmission lines and power apparatus at the end of the line. He patented the complete system, and while it required the expenditure of large sums of money before the manufacturers could develop practical apparatus, still the patents were basic and controlled the art in the United States for many years. To understand the general principal of operation of electric generators and the structural difference between direct and alternating-current machines it is necessary to go back to the fundamental principle of electro-magnetic induction discovered by Michael Faraday in 1831. He noticed that when a loop of wire of several turns was revolved between the poles of an electro-magnet a flow of electric current took place in the wires of the loop. The rotation of the loop was about an axis perpendicular to the lines of force emanating from the pole.

The term electromotive force represents the pressure which forces an electric current through a circuit. In a generator its magnitude depends upon the rate of cutting of magnetic lines of force. These lines of force are hypothetical and indicate the magnitude and direction of the force of a magnetic field. To continuously produce an electromotive force, continued cutting of lines of force is essential. The magnitude of the electromotive force induced in a loop which is revolving in a magnetic field is directly proportional to the rapidity with which the loop is revolved, to the number of turns of wire in the loop and to the strength of the magnetic field. The direction of the E. M. F. induced in a loop depends upon the position of the loop relative to the poles. When one of the wires of a loop passes one pole, an E. M. F. is induced in the wire which tends to send a current in one direction, this direction changing as the wire cuts the flux at the other pole. Opposite sides of the loop pass poles of opposite polarity simultaneously, a current therefore tends to flow in one direction around the loop. The direction of the E. M. F. in the loop changes as the wires pass from a north to a south pole. When the loop is connected by two slip rings, as illustrated in Fig. 1. and revolved, an alternating current may be obtained by attaching to the slip rings suitable collecting devices. The substitution of a two-part commutator, Fig. 2, for the slip rings will rectify the current and produce a direct current, or a current which flows continuously in one direction.

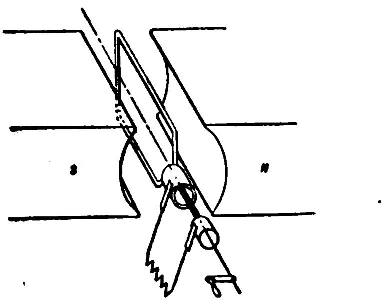

FIG. 1.

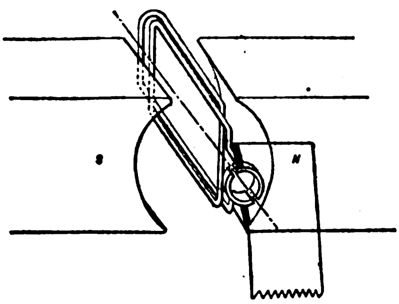

FIG. 2.

Modern electric generators are divided into two distinct classes, those which generate a direct current and those which generate an alternating current. It is customary, with a few exceptions, to term the part of a machine in whose coils the E. M. F. is generated the armature, and the parts that produce the flux the field magnets. Dynamo electric machines are further classified as to their mechanical operation into machines in which: (a) The armature revolves and the field magnets are stationary; (b) the field magnets revolve and the armature is stationary; and (c) the field and armature coils are stationary and iron core revolves. It is obvious from previous mention that a dynamo electric machine may supply either a direct or an alternating current depending upon whether it is fitted with a commutator or with slip rings. Machines termed rotary converters possess both a commutator and slip rings, their function being to convert alternating into direct current or vice-versa. If the machine be driven by an external force, either direct or alternating current may be obtained by making the proper brush connections. The rotary converter when operated in this manner is termed a double-current generator. As the construction of the armatures of direct-current machines, rotary converters and a large number of alternating current machines is similar with the exception of their commutators or slip rings, the construction of the armature of a direct-current machine will be given in detail.

Direct-current Armatures.—A direct-current rotative armature consists essentially of three parts, an iron core mounted upon a shaft, a number of conductors wound upon the surface of the core or embedded in slots near the surface, and a commutator. See ELECTRIC DIRECT CURRENT.

Core.— The object of the core is to facilitate the passage of lines of force from one pole of the field magnet to another. If this core were not present fewer lines of force would pass through the armature, and this would tend to decrease the E. M. F. generated by the machine. For equal magnetizing forces a sample of iron may carry 2,500 times the number of lines of force that would be carried if air were substituted for it. An iron core in a coil is 2,500 times as strong a magnet as a coil having no core.

The periphery of the armature core of large machines is usually slotted longitudinally, the purpose of which is to admit the conductors and to decrease the air space, termed the air-gap, between the core and the pole faces, a thing which is very desirable.

The core is composed of iron discs punched from sheets. These discs are punched out whole for small machines, or are made in segments, the junctions of which are staggered in large machines. The discs in machines of large capacity are mounted upon a form of proper dimensions, which in turn is fastened to a spider and keyed to the shaft. The punchings are assembled with their planes perpendicular to the axis of rotation. The reason for using discs instead of a solid casting is that the iron core is equivalent to a conductor revolving in a field. Currents, termed Foucault currents, flow through the iron in the direction of the axis if the discs are not properly insulated. This current unduly heats the armature and is therefore undesirable.

Armature Windings.— The wires distributed over the periphery of the core of an armature constitute the generating part of a direct-current machine. Armatures in which the windings are only upon the periphery are termed drum armatures. When the core of the armature is in the form of a ring and the wires are wound in and out around the ring the armature is called a ring armature. Drum armatures are in use commercially to a greater extent than ring armatures particularly in the case of large machines. In the drum armature a greater portion of the winding is active in producing an electromotive force than in the ring armature. The ring armature has considerable wire upon the inner face of the ring in which very little eletromotive force is induced.

The length of active conductor connected in series on an armature determines the magnitude of the electromotive force generated by a given magnetic field. In machines of large magnitude two volts or more are generated per foot of active conductor.

Many forms of armature winding are in vogue. The designing engineer is often called upon to design a machine of given capacity which will generate a certain pressure at a definite speed. To do this he must place sufficient wire in series to produce the required E. M. F., and this wire must be of sufficient cross-section to carry the current it will be called upon to deliver. To meet these conditions and still have an armature which is not abnormal in size often results in a very complicated series multiple winding. Machines of large capacity usually have more than one pair of poles and have brushes between successive poles around the commutator. These serve to conduct the current to the main circuit.

An economical method of winding drum armatures consists in the employment of formed coils. These coils are wound upon a collapsible form of proper dimensions and after being thoroughly insulated and shellacked are removed from the form. They are then inserted in the slots of the armature core. The distance between the two halves of the loop is nearly equal to the distance between the centres of two poles of opposite polarity. The terminals of the loop are connected to two adjacent commutator segments. The next loop is placed in slots and similarly connected, care being taken to connect the two coils in series to a common commutator segment. By this method the current tends to flow in one continuous direction. Many modifications are made to this form of winding but the principle of connecting the coils so that their E. M. F.'s will be cumulative is common for all machines. Some machines have two or more separate windings upon the same core.

Commutators.—A commutator consists of an assemblage of small forgings or castings of copper called segments, Fig. 3, which are thoroughly insulated from each other. These segments are assembled around a tube. The tube is threaded at both ends to receive nuts to hold the segments together. Mica is usually employed to insulate the segments from each other, from the nuts and from the tube. In addition to its high insulating properties, mica possesses the advantage that it wears under the brushes at about the same rate that copper does. This maintains a smooth surface at all times upon the surface of the commutator. The maximum voltage between adjoining segments is seldom allowed to exceed 20 volts. Assuming that the voltage is uniformly distributed, a 240-volt machine with a closed winding would therefore have 12 bars between adjoining brushes, or for a two-pole machine 24 commutator segments. In Fig. 3 the perpendicular projection, "P," of

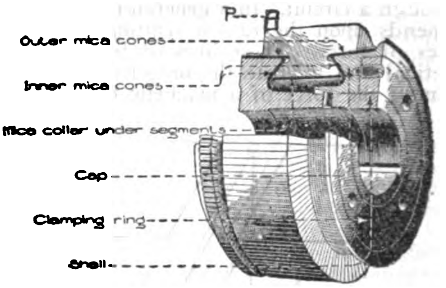

FIG. 3.

the commutator segment protects the coils on the armature, and is made to receive the extremities of the coils of the armature windings. The wires in some cases are fastened to the lugs, "P," with set-screws and then soldered. The commutator complete is keyed to the armature shaft.

Brushes.— Carbon and copper are the two materials usually selected for brushes; carbon for high potential machines and copper for low potential machines. When a coil is entering commutation it has a current of electricity flowing in it. The direction of this current changes when the coil is commutated. The current flowing in the coil before commutation tends to keep up because of its self-induction. In the time it takes a strip of insulation to pass under the brush, the current flow in the coil must be stopped, and a current of equal value started in the opposite direction. Both operations may be done by counter E. M. F., or the current flow may be stopped by a high resistance and started by fringe flux. The transition resistance of brush to commutator usually causes a fall in the potential of about one volt for every brush. The pressure of the brushes against the commutator varies, the average value is about 1¼ pounds to the square inch. The necessary area of rubbing surface of carbon brushes is one square inch for 40 amperes, and copper brushes permit of 200 amperes for the same cross-section. See Fig. 5.

Field Magnets and Field Frame.— The field magnets produce the magnetic flux in which the armature rotates. The flux is created by a current of electricity traversing many turns of wire which are wound upon iron cores. A north or a south pole is produced, depending upon the direction in which the current flows through the coil. The coils on the field magnets are connected in series and so arranged that the polarity changes consecutively from pole to pole. Modifications are sometimes made to this form of winding when it is desirable to produce a machine which will supply a three-wire circuit. The machine is then designed as a four-pole machine having two adjoining north poles and two south poles similarly placed.

The laws governing the flux of magnetic lines are similar to the laws of current flow. The flux which will flow in a magnetic circuit is equal to the magnetizing force (termed the magnetomotive force) divided by the reluctance of the circuit.

$$\text{Flux} = \frac{\text{Magnetomotive Force}}{\text{Reluctance}}$$

The reluctance of a magnetic circuit is a property analogous to the resistance of an electric circuit. To obtain a maximum flux through an armature with a given magnetomotive force it is necessary to reduce the reluctance of the magnetic circuit to a minimum.

In the design of a generator it is often convenient to first design the armature and then obtain the magnitude of the flux which must be generated by the field magnets. Having selected a given material for a field frame, a given air gap, a given length and cross-section of magnetic circuit, the total reluctance of the circuit is determined. The reluctance varies directly as the length of the circuit, directly as the reluctivity of the material and inversely as the cross-section. Knowing the total flux and the reluctance of the circuit, the magnetomotive force is determined, and this quantity divided by 1.257 gives the number of ampere turns necessary to produce the magnetic field.

Field Coil Connections.— Generators may be shunt wound, series wound or compound

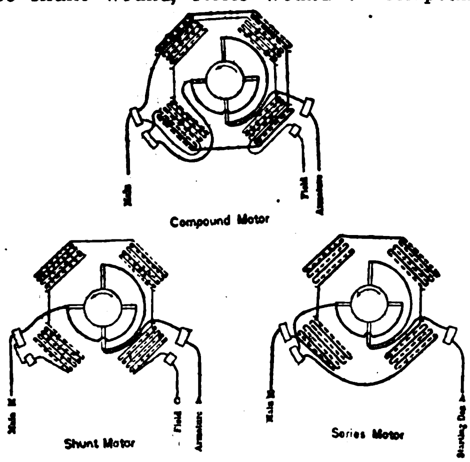

FIG. 4.— Connections of series, shunt, and compound generators.

wounds. (See Fig. 4.) In the series generator the armature circuit, the field circuit and the external circuit are all in series. Series motors are used for traction purposes as they give a large starting torque. Series dynamos are used for arc lighting, as they generate a constant current. Shunt wound machines have their field circuit, their armature circuit and their external circuit connected in multiple. A shunt machine is designed to generate a constant potential, or when operated as a motor to run on constant potential. The field coils of a generator may be separately excited, in which case an external source furnishes the current for exciting the coils. Separately excited machines are usually employed in large power-houses where it is desirable to have a flexible system, which means the ability to vary the pressure sent out on the line at any instant of time. In the United States where 40,000 horse-power generators are now in successful operation, each machine is taken as a unit and the control of the exciting current for the fields is a very important factor. The machines are separately excited; the exciting dynamo being supplemented by a bank of storage batteries as an emergency. A compound winding consists of an additional winding upon the field, this winding being connected in series with the line. It may be placed in series with the armature and the field connected in multiple, or it may be connected in series with the armature alone, its connection depending upon the percentage of compounding required. By compounding a machine the strength of the magnetic field is increased in proportion to the current generated by the machine, the percentage depending upon the number of turns in the compound coil and as to the way in which it is introduced in the circuit. If a shunt machine be not compounded, the potential falls with an increase above normal of the generator output.

Methods of Excitation.—A dynamo electric machine may be separately excited or self-excited. When self-excited the machine builds up slowly to its normal potential and when disconnected from the main circuit the field magnets gradually discharge themselves as the speed of the machine decreases. The polarity of a self-excited machine may become reversed or the machine may fail to generate sufficient pressure to magnetize the field magnets. Both of these conditions are serious. When the field coils of the separately excited machine are connected to an external circuit they definitely assume their proper polarity and there is no possibility of this polarity becoming reversed. In addition to this the field magnets of the separately excited machine rapidly build up to the point where the machine generates its normal potential. The disadvantage of this machine is that when disconnected from its external exciting source its fields must be slowly discharged as there is danger of the fields discharging through the insulation of the machine, if it is opened suddenly.

Speed Conditions.— Consider a motor operating under normal conditions from an external supply of E. M. F. The armature of this motor is rotating in a magnetic field and therefore has an E. M. F. induced in its armature windings. The direction of this E. M. F. is such as to tend to send a current of electricity in the opposite direction to that passing through the armature under the influence of the external supply. This E. M. F. is termed the counter electromotive force. The pressure of the external source remains approximately constant and the counter E. M. F. varies with the armature speed. As the motor is loaded its speed tends to decrease. This decrease diminishes the counter E. M. F., and a larger current is permitted to pass through the machine. The difference between the impressed and the counter E. M. F.'s divided by the resistance of the armature gives the magnitude of the armature current. It is obvious that a very large current would flow through a stationary armature of low resistance, if the armature were connected directly to an ordinary commercial lighting or power circuit. To prevent this large current flow, devices called starting boxes are employed for starting motors. The function of a starting box is to first complete the exciting circuit of the field magnets and then gradually to cause a rise of the impressed potential upon the armature terminals, from zero to that of the supply circuit. The latter is accomplished by gradually diminishing resistance which is in series with the armature until the speed of the machine is almost normal, when all the resistance is entirely removed.

Nikola Tesla was the first to see the possibilities of generating alternating currents. This invention is called Tesla's rotating magnetic field, and it made possible the present long-distance transmission of power by electricity. This condition has led to expansion of territory by the users of alternating-current dynamos, until practically all companies engaged in the distribution of electricity have settled down to the same practice, generating current with alternators of the polyphase type at large central stations and transmitting it at high pressure to substations, where it can be sent out under lower pressure, as either direct or alternating current, or used to charge storage batteries.

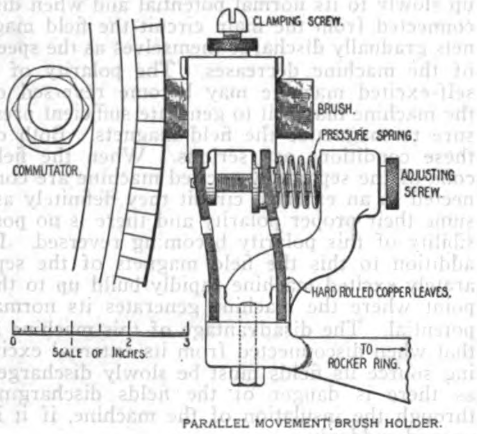

FIG. 5.—Standard Brush Mounting.

Induction Motors.—In the year 1888, Mr. Tesla introduced his dynamo electric machine, which is now termed an induction motor. This motor had two great advantages over the direct-current motor, in that it possessed no commutator or brushes to be cared for, and it could be operated by alternating currents. It possessed the disadvantage that there was no ready means of regulating its speed. There is considerable difference between the construction of an induction motor and that of a direct-current motor. Induction motors have a revolving element whose laminations are somewhat similar to those of the armature of a direct current motor, as they fulfil the same function. The movable part of an induction motor is called the rotor and the stationary element surrounding the rotor is called the stator. In a common form of rotor, called the squirrel cage, the inductors are insulated and embedded diagonally in slots around the periphery, and at each end of the rotor these inductors are connected together to a common ring. The coils of the stator which create the magnetic field are so wound that several out-of-phase alternating currents have their magnetic actions superimposed upon each other and thus produce a field which continually shifts. This field is termed a rotating field. The stator field induces currents in the rotor which react upon the field and cause the rotor to revolve. The motion of the rotor is not synchronous with respect to the field of the stator, but slower. The ratio of the deficit of the rotor speed to the speed of the stator field is termed the slip of the induction motor.

Time Limit Relays.—Generators are liable to be subjected to an excessive overload for a short period of time. This sudden variation in load often occurs in the operation of railroad trains, mining machinery, mills and machines of a similar nature. It would be very inconvenient to have breakers open the circuit whenever these sudden variations in load occur, especially as the generators are usually designed to stand an overload of 25 per cent for half an hour and an overload of 50 per cent for one minute. The time limit relay performs the same function that a circuit breaker does, namely, opens the circuit whenever an excessive overload occurs. There is this difference, however, between the two devices: the operation of a circuit breaker is practically instantaneous, whereas a time limit relay has a time element associated with it. This time element is adjustable and may be arranged so that the circuit will be opened after a definite interval of time following the overload. In one form the magnetic action of the relay is opposed by a bellows or a dash-pot, which contains air. When the relay begins to operate, a solenoid draws a plunger down, which in turn compresses air in a receiver. The force exerted by the compressed air is lessened by leakage. When the limit is reached, say five seconds, the circuit breaker is automatically opened.

Reverse Current Relay.—If a generator become disabled and is unable to develop a pressure equivalent to that generated by machines linked in with it, there is a possibility of a large cross-current flow into the disabled generator from the other machines. To prevent power returning into such a machine a device termed a reverse current relay is employed which automatically cuts out the machine from the service.

Lightning Arresters.—Transmission and distributing systems are subject to abnormal voltage strains due to lightning and potential surges. These disturbances tend to weaken or destroy the insulation of the circuit. While there is nothing that will protect electrical apparatus from a direct stroke of lightning, still means have been provided to protect the insulation from the induced potential resulting from lightning discharges occurring in its vicinity and also from surges which sometimes occur during the operation of the system. It is customary to protect transmission lines by installing one or more overhead ground wires which are frequently grounded at intervals along their course. The object of these ground wires is to shield the transmission wires from the influence of lightning and also to provide a freer path for the lightning discharge to the earth. These ground wires are not, however, perfect protection and some of these potential disturbances travel along the transmission line to the generating or substations. Hence, protective apparatus is needed at the point where each line enters the station. As lightning frequently oscillates with a very high frequency, a reactance coil, commonly called a choke coil, is installed at this point to impede the discharge of lightning and make it tend to seek another path. This auxiliary path is provided by the lightning arrester which is connected to each line at the point where the transmission circuit is connected to the choke coil. The lightning arrester consists of a path of low impedance which has a means provided for preventing the normal line current flowing to ground following lightning discharge. The most efficient form of lightning arrester is known as the aluminum cell arrester which consists of a number of cells formed of aluminum plates upon which are special films which have a remarkable property of allowing only a small leakage current to flow through the cells in normal potential which will allow higher or abnormal voltages to be discharged to ground. This form of lightning arrester is used for both alternating and direct current circuits. Another form of arrester is the graded shunt multigap. This arrester consists of multiple paths containing graded amounts of resistance in parallel with spark gaps. The application of these multigap arresters is confined to lower voltage alternating current circuits. For the protection of direct current circuits, there is, in addition to the aluminum cell, several forms of gap arrester. These consist of gaps in series with a low resistance and a means provided for extinguishing the power current which follows the lightning discharge across the gap. The best-known form is the magnetic blow-out type which has a magnetic coil connected in shunt with a part of the resistance. When the lightning discharges to ground through the gap and resistance, the line current sustains the arc at the gap. This current flowing through the coil produces a strong magnetic field in the gap which repels the arc through a suitably formed arc chute by means of which it is quickly extinguished and the circuit restored to normal conditions of operation.

Central Station Economics.— It is desirable to reduce the initial cost of the production of electric power to a minimum wherever fuel is expensive and natural sources of energy, such as water power, are absent. Such conditions are met with in many of our large cities. This reduction is accomplished by installing engines and generators of the highest efficiency and by employing all methods which will tend to increase the efficiency of the plant. One of these methods is to directly connect the armature of the generator to the shaft of the engine. This eliminates the friction losses which would occur if belting were employed, but necessitates good speed regulation, as the pressure of a generator is directly proportional to the speed with which it rotates. It is essential for good service that the speed be regulated to within 1 per cent, otherwise lights will flicker and their use will be objectionable. Sometimes in large electric-lighting systems the voltage of a given part of the system may vary as much as 5 per cent, but this variation is not continuous and is due more to the local loading of the mains and not to the generator at the central station.

Throughout the western part of the United States much use is made of water power for generating purposes. Power-houses are situated in the bottom of ravines and are operating under heads of water as great as 2,000 feet. The famous Colgate plant on the Yuba River has transmitted power 253 miles, one of the longest power transmissions in the world. Although the cost of water is small compared with the cost of coal, still the cost of electric power

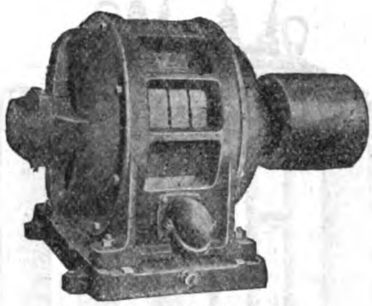

Fig. 6.— Direct Current Motor.

generated from water is not much cheaper than when generated from coal. This is due to the fact that the initial investment in a water-power plant is much greater than in a steam plant of the same magnitude. Much capital must be spent in the construction of expensive dams, waterways and pipe lines.

Transformers.— One of the greatest advantages of electrical energy over other forms of energy is its flexibility. It may be generated in one place, and its pressure may be trans-

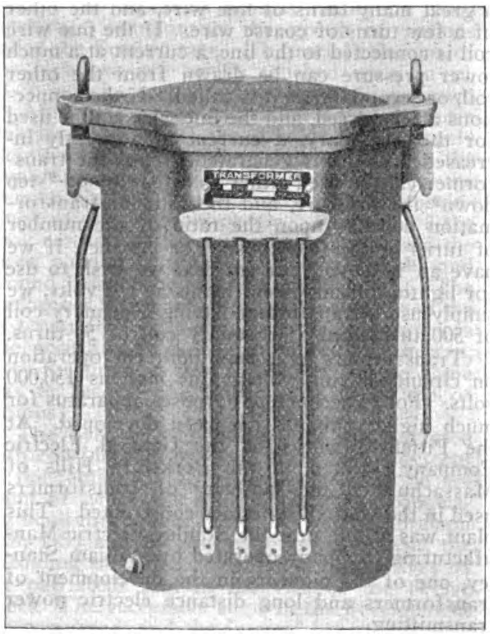

Fig. 7.—Common type of air-cooled transformer.

formed from a low voltage to a high voltage. The electrical energy in this form may be transmitted to a distant place where the reverse transforming process occurs. The higher the voltage under which power is transmitted the smaller need be the cross-section of the transmission line. A stationary static transformer operating upon the principle of induction is all that is essential to transform alternating currents, but with direct current transformation, it is necessary to employ rotating apparatus.

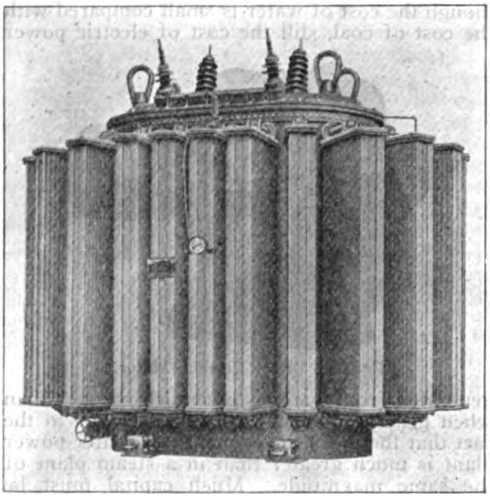

FIG. 8.—Transformer with external radiator.

In principle the transformer is a sort of modernized induction coil. Its essential parts are a core of laminated sheet-iron, wound with two coils of copper wire, one coil consisting of a great many turns of fine wire, and the other of a few turns of coarse wire. If the fine wire coil is connected to the line, a current at a much lower pressure can be drawn from the other coil, or secondary, as it is called. If the connections are reversed, and the fine wire coil be used for the secondary, a current at a greatly increased pressure is generated. Thus the transformer can be used either to «step up» or «step down» the pressure, and the ratio of transformation depends upon the ratio of the number of turns in the two coils. For instance, if we have an 1,100-volt current that we wish to use for lighting incandescent lamps at 110 volts, we simply use a transformer having a primary coil of 500 turns and a secondary coil of 50 turns.

Transformers have been built for operation on circuits having voltages as high as 150,000 volts. For experimental purposes apparatus for much higher voltages has been developed. At the Pittsfield works of the General Electric Company, located in the Berkshire Hills of Massachusetts, the majority of transformers used in the United States are constructed. This plant was at one time the Stanley Electric Manufacturing Company operated by William Stanley, one of the pioneers in the development of transformers and long distance electric power transmitting.

At the Pittsfield works 6,000 hands are employed. Here elaborate testing equipment is provided for testing transformers and for research work. In figs. 7, 8 and 9 are shown three types of transformer in general use in the United States.

Without the transformer, long distance electric power transmission would be practically impossible. Therefore, with the development of the alternating current system of distribution, the use of the transformer has become very extensive. As the voltage and size of transformers have been increased, extensive development has been necessary to overcome the problems involved.

In the early development of the transformer air was used generally for cooling the windings. With the advent of oil as an insulating and cooling medium, the possibilities of the transformer were extended. With the increase in demand for large transformers several forms of tanks for radiating the heat produced in the transformer were developed. For transformers cooled by the air, circulating around the tank, corrugated tanks or tanks with external radiators were used to increase the amount of surface exposed. For larger sizes of transformers cooling coils were submerged in the oil and water passed through the coil, thus dissipating the heat. In this way larger output was obtained with a smaller floor space. Transformers have been built in sizes up to 25,000 kv-a.—such transformers being cooled by means of water passing through cooling coils as indicated above.

It is not considered good engineering practice in the United States to use direct current for transmission purposes. Alternating current is used for this purpose and direct current is employed for distribution. Several machines have been designed which will transform direct current from one voltage to another voltage. They are termed motor-generators, dynamotors and boosters. A motor-generator consists of a motor and a generator coupled together upon

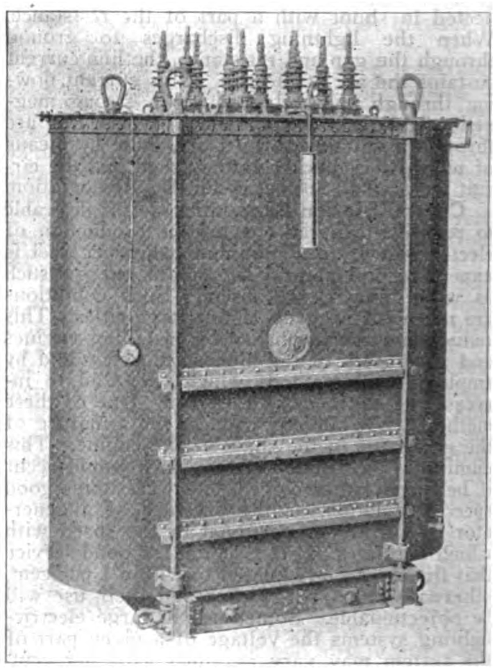

FIG. 9.—Water-cooled transformer.

one shaft. The speed of the motor may be varied, which will correspondingly alter the voltage generated by the dynamo. A dynamotor consists of two armature windings upon the same core, rotating in one field. The armature has two commutators, one at each end of the shaft. This type of machine has practically no armature reaction and therefore has a small tendency toward sparking. The main disadvantage of this machine is that it is impossible to vary the field strength for purposes of regulation without correspondingly altering the voltage of the dynamo. A booster is a machine used extensively to raise the potential of railway feeders. Its armature is usually placed in series with the feeder and driven by some external source of energy. When its field coils are in series with the line, it is termed a series booster, and when the field coils are connected in multiple it is called a shunt booster. The capacity in watts of a booster is determined by the product of the feeder current into the maximum change of voltage which it causes.

Fuses.— The simplest protecting device consists of a fuse. Fuses are made in many forms. The link fuse is made in strips, or as wire of an alloy possessing a low melting point. When the current strength exceeds a certain limit, the heat developed in the fuse by the pressure overcoming the resistance of the fuse is sufficient to melt it and interrupt the service.

Circuit Breakers.— Where heavy currents have to be interrupted an electro-magnetic device termed a circuit breaker is employed. This device consists of an electro-magnet of low resistance placed in series with the circuit. When the current in the circuit exceeds the normal amount, the magnet attracts an armature which releases a catch, and allows a spring to open the switch governing the circuit.

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GENESEE (jĕn-ĕ-sē) **RIVER**, a remarkable stream rising in Pennsylvania, and flowing nearly 200 miles north through western New York into Lake Ontario, seven miles north of Rochester. The Genesee is famous for its extraordinary falls. Three of these occur within a distance of one and one-half miles; two are respectively 68 and 90 feet high, and the Portage Falls are 110 feet high. The river has also a sheer fall of 95 feet at Rochester, utilized for water power; and another cascade, a few miles below, is almost as high.

GENESEO, Ill., city in Henry County, 20 miles southeast of Moline, on the Chicago, Rock Island and Pacific Railroad. It contains a Collegiate Institute, public library and city hospital, also canning factories. It has extensive agricultural and stock raising interests and has a large trade in farm produce and live stock. It owns the water supply system. The government is vested in a mayor and council. Pop. 3,200.

GENESEO, N. Y., village and county-seat of Livingston County, 30 miles from Rochester, on the Genesee River and the Erie Railroad. The State Normal School and Wadsworth Public Library are situated here. It is an agricultural town, has a large vegetable canning factory, and manufactures jam, flour, gloves and mittens. The waterworks are the property of the village. Pop. 2,067.

GENESIS, Book of. Name.— The book of Genesis is the first of the so-called «Five Books of Moses» or the «Pentateuch» (q.v.), which constitutes the first division of the Hebrew Bible. Its Hebrew name is *Bĕrēshīth*, «In Beginning,» after the opening word of the book in Hebrew. The designation *Genesis*, meaning «Generation» or «Origin,» is derived from the translation of Genesis ii, 4a in the early Greek translation known as the Septuagint (q.v.), and is meant to be descriptive of the contents of the books.

Contents.— The book of Genesis falls naturally into two parts: I. The beginning of all things (i, 1–xi, 9). II. The stories of the Patriarchs (xi, 10–l, 26). All ancient peoples sought answers to the questions, Whence came the World? Whence came man? How did sin come into the world? How did different languages and races arise? etc. Genesis i, 1–xi, 9, contains the answers of Hebrew religious thinkers to these questions. The chapters tell of the creation of heaven and earth, man's original habitation, the entrance of sin into the world, the beginnings of civilization, and the growth of population. The spread of sin and wickedness, following the development of civilization, was punished by a flood which destroyed the human race, with the exception of one family; the descendants of this family repeopled the earth and gave rise to various nations and races.

From the beginning of things in general the book passes to the beginnings of the Hebrew people, in which the author is primarily interested. The Hebrews possess numerous characteristics common to the group of nations called the Semitic race. The racial relations of the Hebrews are briefly touched upon in xi, 10–26, which traces the genealogy of Shem down to Abraham, whose migration from southern Babylonia (Ur of the Chaldees, commonly identified with the modern *Mukayyar*, near the Euphrates, about 125 miles northwest of the Persian Gulf) to Canaan marks the first beginnings of the Hebrew people. The rest of the book consists of narratives centring around the three patriarchs, Abraham, Isaac, Jacob, and around Joseph, the favorite son of Jacob. (The book gives «Abram» as the original name of the first patriarch; the change to «Abraham» was due, according to the popular etymology in xvii, 5, to the promise that the bearer of the name was to become the father of a multitude of nations).

The lives of the men named are narrated with considerable fullness, down to the descent of the family of Jacob into Egypt, with an account of which the book closes. The connecting bond throughout is the promise to Abraham (xii, 1–3) and the covenant based upon it, the unfolding of which is exhibited in the lives of the patriarchs and in the rise of the twelve tribes. The successive steps in the development are connected, and the interest is concentrated, by the use of the formula, «These are the generations of»: Shem, xi, 10; Terah (Abraham), xi, 27; Ishmael, xxv, 12; Isaac, xxv, 19; Esau, xxxvi, 1, 9; Jacob, xxxvii, 2.

Composition.— In its present form Genesis is a compilation of material taken from three originally separate sources, commonly designated by the letters J, E and P. (For proofs of this assertion and for the significance of these symbols see article PENTATEUCH). Material from J and P is found throughout the entire book. E does not appear to any extent until chapter xx, though some extracts are found in chapter xv. J comes from the 9th century, E from the 8th and P from the 6th or 5th. Though not without distinguishing characteristics, in substance of tradition as also in manner of treatment J and E closely resemble each other — due in large part to the fact that both come from the creative age of prophetic narration; hence it is not always easy to disentangle them; on the other hand, P is easily distinguished from the JE elements.

J is a first class narrator; in vigor, simplicity and artistic skill he is without equal in the Old Testament; the style of E is perhaps a little more terse than that of J, and at times may lack the spontaneous charm and strength of the other; but on the whole it is not easy to tell where the E narratives are inferior to J. The style of P is cold, precise, stereotyped and prosaic. (For a more complete characterization of the several documents and a discussion of the manner of compilation see article PENTATEUCH; for an analysis of the book of Genesis according to the several sources consult any modern commentary or Old Testament Introduction. The contents of each source are reproduced consecutively in Kent, C. F., 'The Student's Old Testament'; Carpenter and Battersby, 'The Hexateuch'; Brightman, E. S., 'The Sources of the Hexateuch').

Genesis and Archæology.— This subject is of importance because of its bearing on the historical value of Genesis. For an adequate consideration of the subject it may be of value to separate the stories in Genesis i, 1–xi, 9 from the patriarchal narratives in xi, 10–l, 26. Archæology has discovered in the literature of Babylonia myths and legends which strikingly resemble some of the stories in Genesis i–xi. The parallels are closest in the accounts of creation and of the flood, but the resemblances are by no means confined to these. There are certain features in the Genesis story of paradise and of the fall which strongly point to Babylonia; the antediluvian patriarchs have their counterparts in Babylonia, and the story of the Tower of Babel certainly presupposes a knowledge of Babylonia and may rest upon some Babylonian legend.

The resemblances are easily accounted for. The Hebrews were Semites; so were the Babylonians. Peoples belonging to the same race, springing from a common stock, might be expected to possess similar traditions and beliefs. Moreover, as the result of more or less constant intercourse between Assyria-Babylonia and Palestine elements of Babylonian civilization would inevitably find their way to the lands and nations along the eastern shore of the Mediterranean Sea.

However, the numerous points of contact must not blind the eye to the presence of even more significant points of contrast. The latter appear principally in the spirit and atmosphere pervading the Hebrew stories, which separate these widely not only from the Babylonian stories but also from all similar stories in other extrabiblical literature. While there is in many cases agreement in form, there is in the Hebrew records «an intensity of spiritual conception, a sublimity of spiritual tone, an insight into the unseen, a reliance upon an invisible yet all-controlling power, that create the gap between the Hebrew and his brother Semite beyond the River.»

Archæology has thrown little light on the patriarchal narratives; for not a single incident in the patriarchal story is referred to in any of the inscriptions read thus far. On the other hand, as the result of archæological investigation, the age of the patriarchs has been wonderfully illuminated. In the words of one scholar, «Formerly the world in which the patriarchs moved seemed almost empty; now we see it filled with embassies, armies, busy cities and long lines of traders passing to and fro between one centre of civilization and another.» «But,» he continues, «amid all that crowded life we peer in vain for any trace of the fathers of the Hebrews; we listen in vain for any mention of their names; this is the whole change archæology has wrought: it has given us an atmosphere and a background for the stories of Genesis; it is unable to recall or certify their heroes.»

Permanent Significance of the Genesis Narratives.— Here again it is necessary to separate the narratives dealing with the beginnings of things, i, 1–xi, 9, from the patriarchal narratives, xi, 10–l, 26. Formerly the opening chapters of Genesis were thought to give an absolutely accurate account of creation and of the earliest history of mankind. But as the result of investigations along various lines this view has become untenable. «We are forced,» says a well-known commentator, «to the conclusion that though the writers . . . report faithfully what was currently believed among the Hebrews respecting the early history of mankind, yet there was much they did not know, and could not take cognizance of. These chapters consequently contain no account of the real beginnings, either of the earth itself, or of man and human civilization upon it.» Which means that if any one is in search of accurate information regarding the age of the earth, or its relation to sun, moon or stars, or the exact order in which plants and animals first appeared, or the rise of civilization, or the origin of languages and races, and similar questions, he should go to books embodying the results of scientific and historical investigation and not to the book of Genesis. So far as the scientific or historical knowledge furnished in the latter is concerned it is of little more value than that contained in similar stories among other nations.

Nevertheless there is a difference in value between these Genesis narratives and extrabiblical stories describing the same unknown ages. The latter are of interest simply as relics of a distant past. Not so the biblical narratives: They are and ever will be of inestimable value, not because of their scientific teaching, but because they embody sublime religious truth in the crude forms of primitive science. Consequently, if any one, instead of searching for accurate scientific information, wishes to know what connection the world has with God; if he seeks to trace back all that now is to the fountain head of life; if he desires to discover some unifying principle, some illuminating purpose in the history of the earth, he may still turn to these chapters as a trustworthy guide.

In any consideration of the historical value of the patriarchal narratives it must be kept in mind that, whatever the origin of the book of Genesis, or of the Pentateuch, may have been, these stories were handed down for several centuries by word of mouth; which means that they were exposed to all the dangers which ordinarily threaten narratives thus transmitted. And though it may be granted that among peoples without written records the memory is unusually tenacious, and that popular stories once enshrined in the memory of a clan or tribe may be transmitted practically unaltered for many generations, nevertheless, the possibility of their becoming materially altered must be reckoned with. These modifications may be accidental, due to failure of memory, or intentional, for the purpose of bringing a story into harmony with the ideas, conditions and practices of a later age. As a result it becomes impossible to regard the patriarchal stories as historical authorities in the proper sense of that term.

At the same time, there is insufficient ground for doubting the substantial accuracy of the narratives, properly interpreted. The modern critical view has furnished a strong argument in support of their general trustworthiness. Leaving aside the late P, the older documents J and E offer two independent descriptions of the patriarchal age, one written in Judah, the other in Israel, which, though differing in details, are in fundamental agreement in their representation of early events. In other words, the traditions of north and south appear to go back to what R. Kittel has called «a firm nucleus of consistent tradition.» At any rate, the later history of Israel presupposes a nomadic stage in the people's development such as is described in Genesis xii–1, and there seems good reason for believing that the narratives furnish a truthful picture of general conditions in the patriarchal period. In other words, the patriarchal narratives, though they may contain historical inaccuracies and discrepancies and even legendary elements, are still of considerable value as historical documents.

Moreover, the religious value of the narratives remains undiminished. «Abraham is still the hero of righteousness and faith; Lot and Laban, Sarah and Rebekah, Isaac, Jacob and Joseph, in their characters and experiences are still in different ways types of our own selves, and still in one way or another exemplify the ways in which God deals with the individual soul, and the manner in which the individual soul ought, or ought not, to respond to His leadings.» Historically, as well as religiously, therefore, the patriarchal narratives are of permanent value and significance.

Bibliography.— In addition to those already mentioned the following works in English may be named: Bacon, B. W., ‹Genesis of Genesis› (Hartford 1892); Bennett, W. H., ‹Genesis› (‹New Century Bible,› Edinburgh, no date); Cornill, C. H., ‹Introduction› (London 1907); Creelman, H., ‹Introduction› (New York 1917); Delitzsch, Franz, ‹New Commentary on Genesis› (New York 1889); Dillmann, A., ‹Genesis› (Edinburgh 1897); Driver, S. R., ‹Genesis› (‹Westminster Commentaries,› London 1904); and ‹Introduction› (1891; new ed., 1910); Dods, M., ‹Genesis› (‹Expositor's Bible,› New York 1888); Eiselen, F. C., ‹Books of the Pentateuch› (New York 1916); Gordon, A. R., ‹Early Traditions of Genesis› (Edinburgh 1907); Gray, G. B., ‹Introduction› (New York 1913); McFadyen, J. E., ‹Introduction› (New York 1905); Ryle, H. E., ‹Genesis› (‹Cambridge Bible,› Cambridge 1914); and ‹Early Narratives of Genesis› (London 1892); Skinner, John, ‹Genesis› (‹International Critical Commentaries,› New York 1910). Also articles on «Genesis» in Hastings, ‹Dictionary of the Bible› and ‹Encyclopædia Biblica.›

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GENET, or GENEST, zhĕ'nā', **Edmond Charles Edouard,** French diplomat: b. Versailles, France, 8 Jan. 1765; d. Schodack, N. Y., 14 July 1834. As his father was the chief of the Bureau of Correspondence of the Department of Foreign Affairs, young Genet was early thrown into contact with many foreigners and developed a fondness and talent for foreign languages. In 1777 he translated into French a Swedish history of King Eric XIV of Sweden. In 1789–92, was French chargé d'affaires at Saint Petersburg and from 1793–94, when he was recalled at Washington's request because of attempts to compel the United States to a war with England, was French Minister to the United States. During these years he had had a very wide experience in diplomatic life. He had been attached to the French embassies at Berlin and Vienna, had succeeded to his father's office in the Department of Foreign Affairs; and had been secretary to the French Embassy at Saint Petersburg. On the outbreak of the Revolution he had become an active member of the Girondists; had been sent as Ambassador to Holland and from there as Minister to the United States with instructions to attempt to induce the latter country to declare war against Great Britain. He was also commissioned to fit out privateers in American ports. Encouraged by the warm reception he received on his arrival in the United States he set about his work which included expeditions against Florida, Louisiana and New Orleans, then Spanish possessions. Jefferson warned him that America was neutral in the war and that he must cease his unneutral acts. But he went on with his work, of equipping privateers, which were aided by two French privates. These captured some 50 British vessels and brought them to American ports. The United States government forced his recall. In the meantime the Girondists had got into trouble in France, so Genet remained in the United States, where he became an American citizen and married the daughter of Gen. George Clinton. Consult Genêt, ‹Genêt and the Federal Government› (New York 1793); Turner, ‹Genêt's Projected Attack on Louisiana and the Floridas› (in *American Historical Review,* Vol. III, New York 1898); ‹Policy of France Toward the Mississippi Valley› (in *American Historical Review,* Vol. X, New York 1905).

GENET, jĕ-nĕt', a civet (q.v.) of the genus *Genetta;* also, a trade-name for the fur of this animal, or of some other fur like it. The best known is the common genet (*G. vulgaris*), of the Mediterranean region, called «berbe» in the south of France. It is a very beautiful and graceful animal, gray, with many dark patches, and a full furry tail, banded with black and white. The size is about that of a house-cat. Their fur is made up into tippets, muffs, etc., but is of no great value, and often domestic cat-skins are substituted under the same name.

GENETHLIALOGY, astrology as confined to the prediction of births or foretelling future events from the stars in the ascendant at the time of one's birth.

GENETIC PSYCHOLOGY. The study of the evolution and development of mind is termed genetic psychology. It is the historical aspect, or division, of the general science of mental life, and it is therefore definable, as contrasted with other branches of the science, only in terms of its purpose or aim, which is genetic description. As compared with the genetic psychologist, the student of human psychology is a narrow specialist, for he is intent upon one particular form of mind among the myriads which exist or have existed in the course of the evolution of life.

Divisions.— With respect to its major materials, genetic psychology is divisible into two parts — the study of the development or growth of mind in the individual (technically called the ontogenesis of mind), and the study of the evolution of mind on the earth (technically, the phylogenesis of mind). The nearest popular equivalent for the term psycho-ontogenesis is child psychology; and for psychophylogenesis, animal psychology.

The study of the development of mind in the individual is less difficult and, in many other respects, more satisfactory than that of the evolution of mind, for whereas many of the steps or stages in the latter process have completely disappeared by reason of the extinction of the types of organism to which they belonged, the various stages in individual development are continuously presented for observation. The mental life of the dinosaur cannot, now, be scientifically described because the organism no longer exists, and further, because records of its structure, habits and habitat are extremely meagre. But by contrast, the growth of mind in the mouse, rat, cat, dog, monkey, man, may be described in detail, since each day and hour new individuals of these types are coming into being. The story of mental evolution can be told only very incompletely from direct observation, whereas that of mental growth or development can be told wholly and in detail.

These two divisions of genetic psychology are intimately related and necessarily supplement one another, since the process of phylogenesis is repeated more or less completely in the growth of every individual. According to the theory of recapitulation, mental development in man presents, cinematographically, the major steps or stages in mental evolution. The mental constitution of the gamete, with which, structurally, the existence of the human individual begins, is perhaps comparable with that of certain one-celled plants or animals; that of the fœtus may more or less closely resemble that of various invertebrates; that of the new-born infant may be compared with certain types of lower vertebrate. And so, as the individual develops, racial type after type of mental organization appears, plays its genetic rôle and disappears. Just as in the development of the body, structures, such for example as the gill slits, appropriate to earlier types of organization, appear, function partially or completely for a time, and partially or wholly disappear. Apparently, nothing which has existed in the organic realm is totally lost. Even the extinct dinosaur may have bequeathed to us humans certain briefly visible and functional structures. Who knows but that for some brief period in our existence we are in form, behavior and experience amœba-like, fish-like, monkey-like. G. Stanley Hall, the foremost of genetic psychologists, has picturesquely expressed this idea. «In this process the individual in a general way repeats the history of its species, passing slowly from the protozoan to the metazoan stage, so that we have all traversed in our own bodies ameboid, helminthoid, piscian, amphibian, anthropoid, ethnoid, and we know not how many intercalary stages of ascent.» ('Adolescence,' Vol. 1, p. 2).

Studies in individual mental development constantly suggest problems in mental evolution and the reverse. Thus, the investigation of reacting tendencies or methods of adaptation to environment in an organism at different stages suggests the question, «Do these various tendencies to action and adaptive responses represent different levels of mental evolution? Are they the characteristic and appropriate modes of response of various existing or extinct types of organism?» Otherwise stated, «Do we human beings at first react ineffectively as does the fish, turtle or guinea pig; later, more highly adaptively as does the dog; still later, more intelligently as does the monkey or anthropoid ape?» Such crude questions as these are being asked to-day not idly or vainly, for it is obviously possible to obtain definite, if not complete, answers. There is developing an interest in the problems of genetic psychology which promises soon to tear aside the vale of ignorance and reveal the related processes of mental development and evolution.

Materials.— No fact of mind is valueless for genetic psychology. There are, however, four major groups of psychological materials which are contributing heavily to the advancement of genetic description. They are (1) the facts of individual development as gained from studies of fœtal or embryonic life, infancy, childhood, adolescence, maturity and senility. (2) Of mental characteristics of organic types or races, including the study of man, other animals and plants. For there is as much reason to speak of the psychology of the raccoon, fox, dog, horse, monkey, ape, as of that of man. Indeed, the investigation of more narrowly limited groups of organisms follows hard upon the description of a particular type of living thing. Thus, in ethnic psychology, the attempt is made to describe various kinds of human mind. Similarly, we might have, and doubtless shall have, in the course of the development of science, canine, bovine, feline, piscian and simian ethnic psychology, just as we now have the human. (3) Facts of social relations, which constitute the psychology of social groups. These must necessarily be used because it is the rule that individuals exist in social relations and are mentally different because of the social features of their environment. The evolution of social relations, social groups, institutions, is one phase or aspect of the great task of genetic psychology. (4) The facts of mental deficiency, deviation and disease. These should be made to contribute to genetic psychology, because in psychopathology, stages, phases and peculiar complexes of mind appear dissociated, exaggerated, as it were held up for inspection. In the insane man or lower animal, certain phenomena of response which under normal conditions are difficult to observe may appear clearly. The genetic psychologist would be stupid indeed were he not willing and eager to make use of these apparently bizarre but actually extremely illuminating conditions of mental life in the interests of genetic description.

History.— Genetic psychology, a historical science, lacks historical background, for as a special aspect of psychology, it has only recently been recognized. Formerly, it was hidden in comparative, animal and child psychology.

Clearly enough, the ground for its development was prepared by the evolutional biologists in the last century, notably by Darwin, Wallace, Huxley, Lamarck and Weismann. These and many other observers prepared the way for our modern inquiries into the history of mind. Darwin himself contributed important material to genetic description through his studies of various animals; and somewhat later Romanes set himself the special task of outlining the course of mental evolution.

From these modest beginnings in England, interest in what only very recently has come to be known as genetic psychology spread over the world. The recent developments of this division of psychology can best be described in connection with methods and biological relations.

Methods.— Systematic comparison of facts is the natural and necessary procedure of the genetic psychologist, since he needs above all knowledge of the developmental or genetic relations of his materials. It is not strange, then, that comparative psychology should be used as almost synonymous with genetic psychology. That this usage is not scientifically satisfactory becomes evident when we realize that in strictness comparative psychology should designate a special method of inquiry, whereas genetic psychology should designate a special purpose, task or scientific goal, namely, the description of mental development and evolution.

The closest of relations exists between experimental biology and genetic psychology, for many of the chief problems of the latter are those of heredity. It is not surprising, therefore, that the development of a special science of genetics (for the study of the phenomena of heredity, see GENETICS) should have occurred in biology simultaneously with the development of genetic description in psychology. Ideally, genetics as a biological science should include the study of mind. But since most biologists do not so understand the term, it is doubtless desirable to continue to designate the study of mental development in evolution as genetic psychology or psychogenetics.

Further, the genetic division of psychology is dependent upon other and varied biological sciences, in which ordinarily a student of human psychology has slight professional interest. Among these are palæontology, anthropology, experimental zoology, comparative physiology, comparative neurology and neuropathology. For from these special sciences, facts pertinent to those of mental evolution may be derived by the skilled observer. Indeed, everything having to do with life sooner or later becomes of service to the genetic psychologist. An eminent student of human psychology once remarked, "I am interested in everything human." He referred to the products of human activity as well as to the facts of mind. The genetic psychologist must be able to say, "I am interested in everything living."

Problems.— There are two slightly separable classes of problems in genetic psychology, questions of origin and questions of development or genetic relationship. The former are difficultly soluble; the latter are much more amenable to study.

Of the problems of genetic relations, upon which attention is focused, the following are some of the most important:

(1) Problems of receptivity or the development of sensibility in its various modes, qualities and relations. These all have to do with the so-called special senses or their forerunners.

(2) Problems of affectivity. The appearance in the individual or in the race of forms of feeling, emotion, sentiment; their characteristics, their relationships and their modes of expression are investigated. It has been suggested that feeling, or affectivity, as a mental factor in life, may antedate sensation. This, however, is a problem of origins which remains unsolved. The growth of the affective life in man from birth to maturity is one of the most fascinating chapters of psychology.

(3) Problems of hereditary response or instinct. These properly belong to the general science of genetics and only by reason of necessity does the genetic psychologist attempt their solution. They include all questions concerning instinct as consciousness and as adapted response. In this field a most important question is, "How do instincts originate?" The distant goal of the student of psychic heredity is the ability to create and to control instinctive characteristics.

(4) Problems of individual acquisition, experience or habit. These can be solved completely only in conjunction with problems of instinct, for acquisition is grafted upon heredity. The evolution of the learning process or processes, and the development of modes of learning in various species of organism, constitute a most fascinating and practically important field of inquiry. Language habits are at present commanding attention, as they manifest themselves in infrahuman and in human organisms.

(5) Problems of imagination. These include all questions concerning the genesis of memory, of reproductive imagination and of creative imagination as well. They are of obvious importance, since the transition from mere awareness of the present moment of life to more or less definite consciousness of yesterday and of to-morrow separates the lower from the higher organisms.

(6) Problems of thought and reasoning. Although these are intimately bound up with problems of imagination, they may be discussed separately because reasoning is a form of thinking peculiar to recent stages in mental evolu-

tion. It may or may not prove to be distinctively human, but at any rate it exists in complex form only among the higher mammals. The student of reasoning is beginning to ask, instead of the old question, «Do animals reason?», «What is the genesis and natural history of reasoning processes?»

(7) Problems of the relation of mind to body. Mental evolution exists for the scientist in association with an organism. It is one of his tasks to discover whether there exists some definite mode of energy which should be designated as psychic, and if so, how this energy is produced and how it influences behavior. The notion that mind is epiphenomenal, aloof from life, a sort of penumbra, is in disfavor.

It remains to indicate, briefly, the chief achievements of genetic psychology. The most notable achievements may be summarized under the captions mental development and mental evolution. In both fields of genetic description, progress has been rapid during the last two or three decades.

Mental Development.— Darwin's notes on the mental development of one of his children set the fashion. Ever since, parents, teachers and more disinterested psychological observers have followed his lead. The resulting diary records of mental growth in infancy, childhood and adolescence are invaluable.

The work of Preyer in Germany is conspicuous in the early history of ontogenetic psychology, for he observed carefully, collected and systematically arranged the data of others, and in his several books offered what long remained the best systematic discussion of child psychology. His studies extend even to the mental life of the fœtus or embryo, for in common with many other observers, he recognized signs of mental life prior to the physical incident of birth.

To Preyer and his European contemporaries, psychology owes chiefly its data on (1) the early stages of sensory development: the first appearance of sensory functions in the individual, their characteristics, relations and their rôle in individual development; (2) the essential features of the growth of perceptual consciousness; (3) the important stages in the development of will; (4) the nature and order of co-ordination in experience and in response; (5) the history of language habits; and (6) the development of imagination, thought, reasoning.

To these several groups of facts, important contributions have been made in recent years, so that psychology possesses to-dav a good working outline of the development of the human mind. Such an outline may not be reproduced here even briefly, but it may be obtained from the works of Preyer, Tracy and Stumpfl, Baldwin, Hall and others.

The diary method, by which from day to day new and changing facts of mental life are recorded, has been supplanted by more definitely planned and systematic experimental observation.

Preyer, Kussmaul and others used the experimental method nearly 40 years ago in the study of children. Baldwin experimented with his children, and like Darwin set a fashion. But since experimentation with infants and young children is difficult, progress has been halting.

The Binet method of measuring intelligence and the hosts of practical psychological tests and special scales for mental measurement which have followed upon it are to-day responsible for renewed interest in the problems of ontogenetic psychology. It is even probable that these crude methods of mental measurement will eventually be so perfected as to further the solution of many genetic problems.

Animal psycholopv, other than human, has followed in the path blazed by Darwin and Preyer. First to appear were diary records of the development of young animals. Such are the psychological contributions of Wesley Mills, through his observations of dogs, cats and doves. Similar and more detailed ontogenetic studies have been made with mice, rats and the domestic fowl. Consult the works of Whitman, Craig, Breed, Pearl, Small, Watson, Allen and Yerkes.

Mental Evolution.— Even in the infancy of genetic psychology attempts were made to outline the process of mental evolution. Romanes early presented a general scheme of development, and since his time various other speculative accounts of the course of mental evolution have been published. Such discussions, although obviously demanding facts, have served the excellent purpose of stimulating research. Conspicuously important stages in mental evolution are to-day being studied; but the animal series is a long one, and phylogenetic description is meagre, despite the rapid development of animal psychology. Naturally enough, the line of evolution of the human mind has commanded attention, and in the attempts which have been made to trace our ancestry, many vertebrate types have been studied more or less carefully. But despite their closeness of relationship to us, the other primates have been neglected, chiefly because of their costliness and the difficulties in keeping and studying them. Neither the monkeys nor the anthropoid apes, still less the lower types of primate, have been systematically studied, from the psychological point of view.

For a long time to come, phylogenetic psychology must remain fragmentary and at loose ends. Facts will more and more abound, efforts to correlate them will become more numerous, and more fruitful, but the story is long and it will require persistent and intensive effort to discover it. Yet, logically as well as psychologically, genetic description should be the primary aim of the student of psychology. It should be the material about which special modes of description should centre. Studies of particular groups of facts, as in plant psychology, animal psychology, child psychology, the psychology of sex, of social relations, of ethnic groups; studies by special and peculiar methods, as for example the introspective, comparative, physiological; and studies for particular ends, like the educational, vocational, medical, theoretical, should all exist and thrive, for many and varied reasons. But each should have as its centre of reference genetic psychology.

Bibliography.— Baldwin, J. M., 'Mental Development in the Child and the Race' (New York 1906); Hall, G. Stanley, 'Adolescence' (2 vols., ib. 1905); Judd, C. H., 'Genetic Psychology for Teachers' (1903); Mills, W., 'The Nature and Development of Animal Intelligence'; Moore, K. C., 'The Mental Development of a Child,' 'Psychological Monographs,' No. 3 (1896); Preyer, W., 'The Mind of the Child' (New York 1888-89); Romanes, G. J., 'Mental Evolution in Animals' (London 1885); Spencer, H., 'Psychology' (New York 1890); Shinn, M. E., 'The Biography of a Baby' (1893); Tracy and Stumpfl, 'The Psychology of Childhood' (Boston 1910).

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GENETICS, the science which deals with the coming-into-being of organisms. It is one of the fundamental assumptions of modern biology, amounting almost to an axiom, that no organisms at the present time originate *de novo*, but only from previously existing similar organisms, which either divide to form new individuals by processes called vegetative or asexual, or else produce new individuals from single cells, the so-called reproductive cells. Examples of reproductive cells are the spores of ferns and mosses and the eggs and sperm-cells of the higher plants and higher animals. In some cases the egg-cell of a flowering plant or of an animal, like the spore of a fern, may by itself produce a new individual, but in the great majority of the higher plants and animals (including man and his domestic animals) a new individual arises only from the union of two unlike reproductive cells, an egg-cell and a sperm-cell. These when united, an egg-cell with a sperm-cell, a process which constitutes the "fertilization" of the egg, form a zygote (a joining-together of two reproductive cells) and the zygote grows into a new individual. The fact that an individual so formed resembles its parents is called heredity. It is due, other things being equal, to the similarity in nature of the reproductive cells from which an individual arises and the reproductive cells from which its parents arose. The connection is closer than most persons suppose. In reality the parent does not produce the child nor even the reproductive cell which functions in its origin. The parent is himself merely a by-product of the fertilized egg (or zygote) out of which he arose. The direct product of the zygote is other reproductive cells, similar to those from which it arose. Thus the zygote begins its development by dividing into two cells, these divide into four, and so on until a great number of cells arise, among which differences in form and function can be recognized. Some become bone cells, some muscle cells, some nerve cells, others blood cells, and thus the body is produced. But a very few cells derived from the zygote do not change into anything. They remain, like the zygote from which they arose, reproductive cells and when they leave the body it will be as reproductive cells capable of forming new zygotes. Hence heredity (that is, the resemblance between parent and child) depends upon the close connection between the reproductive cells which formed the parent and those which formed the child, one being the immediate and direct product of the other. This principle of the "continuity of the germinal substance" (reproductive cell material) is one of the foundation principles of genetics. It shows why body changes produced in a parent by environmental influences are not inherited by the offspring. It is because offspring are not the product of the parent's body but only of the germinal substance which that body harbors. Changes produced in the body alone are called *acquired characters* to distinguish them from characters dependent upon the nature of the germinal substance itself, which form the basis of heredity. That "acquired characters are not inherited" follows as a logical necessity, if the principle of germinal continuity is sound. To August Weismann belongs the credit for first making this clear. He mav thus be regarded as one of the founders of genetics. His contribution consists of the two points (1) that the body is a product of the germinal substance plus environment, but is not itself the producer of germinal substance but merely harbors it, inheritance being from germ cell to germ cell; (2) that changes in the body produced by the environment ("acquired characters") are not inherited, since the body is not a vehicle of inheritance. In qualification of these principles, it should be stated that the possibility is admitted, though not conclusively proved, that the environment may directly modify the structure of the germinal substance and thus indirectly affect inheritance, but if so this is not accomplished through the mechanism of bodily changes ("acquired characters") but only of germinal changes. Genetics assumes the validity of the evolutionary hypothesis, that changes in germinal substance do from time to time occur and that thus organisms come into being which differ from their progenitors. If this did not occur, the organisms of to-day would be substantially identical with those of 10,000,000 years ago, which we know from the geological record is not the case. To Charles Darwin belongs the credit for establishing beyond question the fact of organic evolution, that is, the fact that organisms vary and that such variations as best meet the requirements of the environment survive while others perish. Thus from age to age organisms change more or less extensively, though retaining unmistakable resemblances to their progenitors. In terms of Weismann's principles, the variations of organisms which result in evolution have their origin in changed structure of the germ-cells, but the natural selection which determines survival is made upon the bodies which harbor the germ-cells. The practical result is the same as if the germ-cells themselves were subjected to competitive elimination rather than the bodies which represent them as by-products. This more complete analysis of the process of evolution through natural selection was made by Weismann after Darwin's death. Darwin rested with the demonstration of the fundamental fact that organisms vary genetically (that is, as regards the factor of heredity) and that such variations through natural selection result in evolution. He above all others is therefore the founder of genetics. Weismann carried the analysis of the method of evolution an important step farther. He also called attention to the chromosomes of the cell nucleus as the probable "bearers of heredity," these being the components of the germ-cell in which structural changes probably occur which result in heritable changes of body form.

The next important step in the development of the science of genetics was made in 1900 in the rediscovery of Mendel's law of heredity. Gregor Mendel, while a teacher of natural science in a monastic school at Brünn, Austria (between 1858 and 1865) carried out experiments in the hybridization of different varieties of garden peas which led him to the discovery of a fundamental law of heredity, perhaps *the* fundamental law of heredity, known after him as Mendel's law. The discovery was later lost sight of, its fundamental character not being recognized until 1900 when it was rediscovered by Hugo DeVries. This law was promptly verified by numerous other plant hybridizers and was also shown to apply to animals as well as to plants. In accordance with this law it is found that when parents differ, as regards hereditary characters, in several particulars, their descendants may show combinations of those particular characters which were found in neither parent, though other descendants may have the same combinations of characters as the parents had. This leads to the conclusion that separate characters are independently inherited. If we adopt Weismann's suggestion that the bearers of heredity are in the chromosomes, we may suppose that characters which are independently inherited have their determiners in different chromosomes, a conclusion supported by a large amount of evidence derived from a study of the structure of the germ-cells. The greatest probability that such a relationship exists is also afforded by breeding experiments with the fly, *Drosophila,* carried out by T. H. Morgan and his pupils. In these experiments parents have been crossed which differ in many heritable characters and it has been found that certain of these characters tend to be inherited in groups similar to the grouping of characters in the respective parents. But not all the characters of one parent form a single group. There are in reality as many different groups of characters as there are chromosomes in the germ-cell of *Drosophila,* viz., four. The conclusion is drawn that each group of characters has its determiners located in a single chromosome, and that for this reason the corresponding characters usually go together in heredity. There is, however, found a considerable variation in the tenacity with which characters of the same group tend to hang together. Some characters break away from the common grouping more readily than others. It has been suggested that those characters which most commonly go together have their determiners close together in the same chromosome, while those which are more readily separated lie farther apart in the same chromosome. Many lines of experimental evidence support this view, which therefore marks a further important advance in our knowledge of the genetics of both animals and plants, for it has been found that the same phenomenon of «coupled» or «linked» character groups occurs both in animals and in plants.

The science of genetics is still very new, a development of scarce 60 years, but the principles already established are finding important applications in animal and particularly in plant breeding. Hybridization allows of the production of new combinations of the heritable characters found in existing races, some of which new combinations may have distinct economic advantages. Thus our plant breeders seek to combine hardiness and disease resistance found in certain varieties of plants with the greater productiveness of related varieties. Animal breeders often wish to combine the size of one breed with the color, hornlessness or fecundity of another. Mendel's law shows that such combinations are obtainable in a definite number of generations by cross-breeding and indicates the precise procedure necessary to obtain the desired result. But experience shows that the procedure of combining in one race different heritable characters found in separate races is one that requires considerable ingenuity and skill on the part of the breeder. The chief obstacle encountered is the instability in hybridization of the most prized characters of pure-bred races. Characters which clearly follow Mendel's law in heredity, emerging from a cross in new combinations, often emerge in altered form, the desired character of high standard which the parent race possessed emerging with standard lowered. Thus when a parent race possesses an intense black or a clear yellow color which the breeder wishes to transfer to another breed, it is usually found that the intense black emerges from the cross much dulled in character or that the clear yellow has become muddy. Also color patterns, such as those of Dutch-marked cattle, Dutch-marked rabbits and hooded rats, usually emerge from crosses in modified form, which only slow and tedious selection can restore to the original condition. (See STOCK BREEDING). Further, some characters, such as size, seem to blend rather than to segregate in crosses, so extensive is the modification which regularly occurs. It is even an open question whether the inheritance of such characters is not better described as blending than in terms of Mendel's law. This is one of the questions which a further study of genetics must clear up.

The great principles so far established in this subject, or found fundamental to it, are: (1) Organic evolution, origin of new races from previously existing ones by descent with modification and survival of the fittest; (2) non-inheritance of acquired characters; (3) great stability of organic form under vegetative or asexual methods of reproduction, as in grafting, reproduction by stolons, cuttings, etc.; (4) wide prevalence of reproduction by the zygote method (single cells uniting in pairs) among all rapidly evolving organisms such as the flowering plants and higher animals. Since this method allows of crossing in every generation, it favors variability through the production of new character combinations or through character modification; (5) any departure from cross fertilization in reproduction by zygotes, such as the occurrence of self-fertilization among certain plants and among some animal parasites, restores stability of organic form like that found in vegetative or asexual reproduction. Hence the constancy of self fertilizing varieties of cereals and legumes; (6) Mendel's law of heredity shows how in reproduction by zygotes crossing may lead to the production of new character combinations and thus favor progressive evolution; (7) selection acts in two ways upon the variable material furnished by zygote reproduction attended by crossing. (a) It isolates desirable new character combinations. (b) It isolates desirable modifications of characters in combinations already secured. These modifications may arise in consequence of crossing or irrespective of it, as they are known to do in asexual reproduction or among self fertilizing organisms.

Bibliography.— Bateson, W., 'Mendel's Principles of Heredity'; Castle, W. E., 'Genetics and Eugenics'; Darwin, Charles, 'Animals and Plants under Domestication'; Morgan, T. H., et al., 'The Mechanism of Mendelian Heredity'; Weismann, A., 'The Evolution Theory' (Eng. trans. by Thomson).

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GENEVA, Ill., a city and county-seat of Kane County, about 33 miles from Chicago, on the Chicago, Burlington and Quincy and Chicago and Northwestern railroads. It was settled in 1832 and was incorporated as a city in 1887. It is a popular residential section for Chicago merchants. It contains a fine courthouse, a public library, the State Reformatory for Female Juvenile Offenders. The manufactures include windmills, glucose, sadirons, flour, boxes, candy, shoes, sanitary cups and hardware. It is also a milk and butter centre. The city owns and operates its own electric-light plant and water supply. Pop. 2,451.

GENEVA, Neb., city and county-seat of Fillmore County, 55 miles west of Lincoln, on the Burlington and Missouri River and the Chicago and Northwestern railroads. The State Industrial School for Girls is located here. It contains a Carnegie library. The chief industries are brickmaking, farming and stock raising. There is also a large nursery. It owns its water plant. Pop. 1,741.

GENEVA, N. Y., city in Ontario County, on the north shore of Seneca Lake and the main line of the Lehigh Valley, the Auburn Branch and the Pennsylvania Division of the New York Central and Hudson River Railroad. There are two interurban trolley lines connecting with adjacent towns. Rochester is 52 miles west and Syracuse 52 miles east. Geneva is situated in a rich agricultural country and has one of the largest manufactories of cereals and corn products in the United States, using 10,000 bushels of corn daily. The city has extensive manufactories including stoves, steam boilers, optical goods, motors and motor boats, cutlery, glass, etc. The excellent transportation facilities, cheap fuel supply, gas and electric power offering unusual advantages. The United States census of manufactures for 1914 showed within the city limits 52 industrial establishments of factory grade, employing 1,953 persons; 1,692 being wage earners receiving annually a total of $1,054,000 in wages. The capital invested aggregated $4,773,000, and the year's output was valued at $5,241,000: of this, $1,956,000 was the value added by manufacture. The Geneva cutlery works runs out more razors daily than any other factory in the world. Geneva is the seat of Hobart College for men and Smith College for women. The New York Experiment Station and the Smith Observatory are here. Geneva's public, parochial and private schools rank among the best in the State. In the 18th century the Indian village of Kanadesoga was located near the present site of Geneva. Gen. James Clinton attacked and destroyed the village in 1779. Geneva was chartered as a city in 1898 and is governed by a mayor (elected every two years) and a municipal council. The city owns and operates the waterworks. The assessed valuation is $8,000,000. Pop. 15,000, with a tributary trading population of 50,000.

GENEVA, Switzerland, canton, bounded on the north by the canton of Vaud and the Lake of Geneva, and on the east, west and south by France. In addition to the territory thus bounded, the communes of Celigny, Le Coudre, and Petit Bois, enclosed by Vaud, belonged to this canton, which is one of the smallest in the Swiss Confederation, the area being only 108 square miles. The whole canton belongs to the basin of the Rhône, and the only streams of importance are that river and the Arve, which joins it a little below the town of Geneva, the capital of the canton. While the soil is not very fertile, careful cultivation has rendered four-fifths of it productive. It produces cereals, fruits, wine, vegetables in quantities. Its industries, however, make it perhaps the leading canton of the Federation. Near the end of the 16th century the watch-making trade was brought here from France and has become the main industry. Instruments of precision, telescopes, range finders, mathematical instruments, etc., are made in large quantities. Cheap water-power is furnished by the Rhône and has helped to locate these industries within the canton. There are over 500 establishments employing 14,000 workers. The silk industry has declined. As regards government, the Grosser Rat exercises legislative functions and consists of 100 members. There are seven members in the council of state in which reposes all executive functions. There are courts of arbitration for settling matters in litigation between capital and labor and the ordinary courts of civil and criminal jurisdiction. The territory of Geneva having, by the arrangements of the congress of Vienna, obtained an accession of 15 communes, detached from France and Savoy, was admitted a member of the Swiss Confederation in 1814, and ranks as the 22d canton. A constitution, somewhat aristocratical in its nature, was framed, and continued in force till 1830, when a considerable modification of it took place. In 1841, in consequence of a popular tumult, the original constitution was abandoned for one in which the democratic principle is completely predominant. This new constitution was modified under popular pressure in 1847. Nearly one-third of the population is of foreign birth, chiefly French and Italian. About 90 per cent of the inhabitants speak French. The capital is Geneva (q.v.). Pop. 156,288.

GENEVA, Switzerland, the capital of the canton of the same name; at the western extremity of the Lake Geneva, where the Rhône issues, here crossed by several bridges and dividing the town into two portions. The old city is irregularly built and has narrow, crooked streets, except along the river front, where there are several broad highways and well-planned wharves; it is the financial and business section of the city. The Quartier Saint-Gervais, as the section on the opposite bank is called, is the residential section, with several large hotels for tourists, of whom there is always a great number in Geneva. The city contains many fine gardens, promenades, squares and parks, the most noteworthy being the Place des Alpes, the Place Neuve, the Promenade des Bastions, the

Promenade du Lac and the Jardin Anglais. Boulevards occupy the site of the ancient walls of the city. The more important public buildings are the Cathedral or Church of Saint Pierre, a Gothic structure of the 10th, 11th and 12th centuries; the town-house in the Florentine style; the Musée Rath, containing a collection of pictures, etc.; the university building, nearly opposite the botanic garden, rebuilt in 1867–71, and containing the public library, founded by Bonivard in 1551, and now numbering over 200,000 volumes; and the Museum of Natural History. There are several commercial and technical schools and academies of art and music. Geneva is an important manufacturing centre and particularly as a clock, watch and jewelry centre. There are also iron and chemical works, and enameling, diamond-cutting and music box establishments. Scientific and surgical appliances are manufactured on a large scale. It is favorably situated for commerce and exports its own manufactures chiefly to France and Italy. Since 1847 many municipal improvements have been inaugurated, breakwaters protecting the lake harbor, and hydraulic plants supplying water to the city and power to the industrial establishments. The city owns and operates the gas and electric-lighting plants.

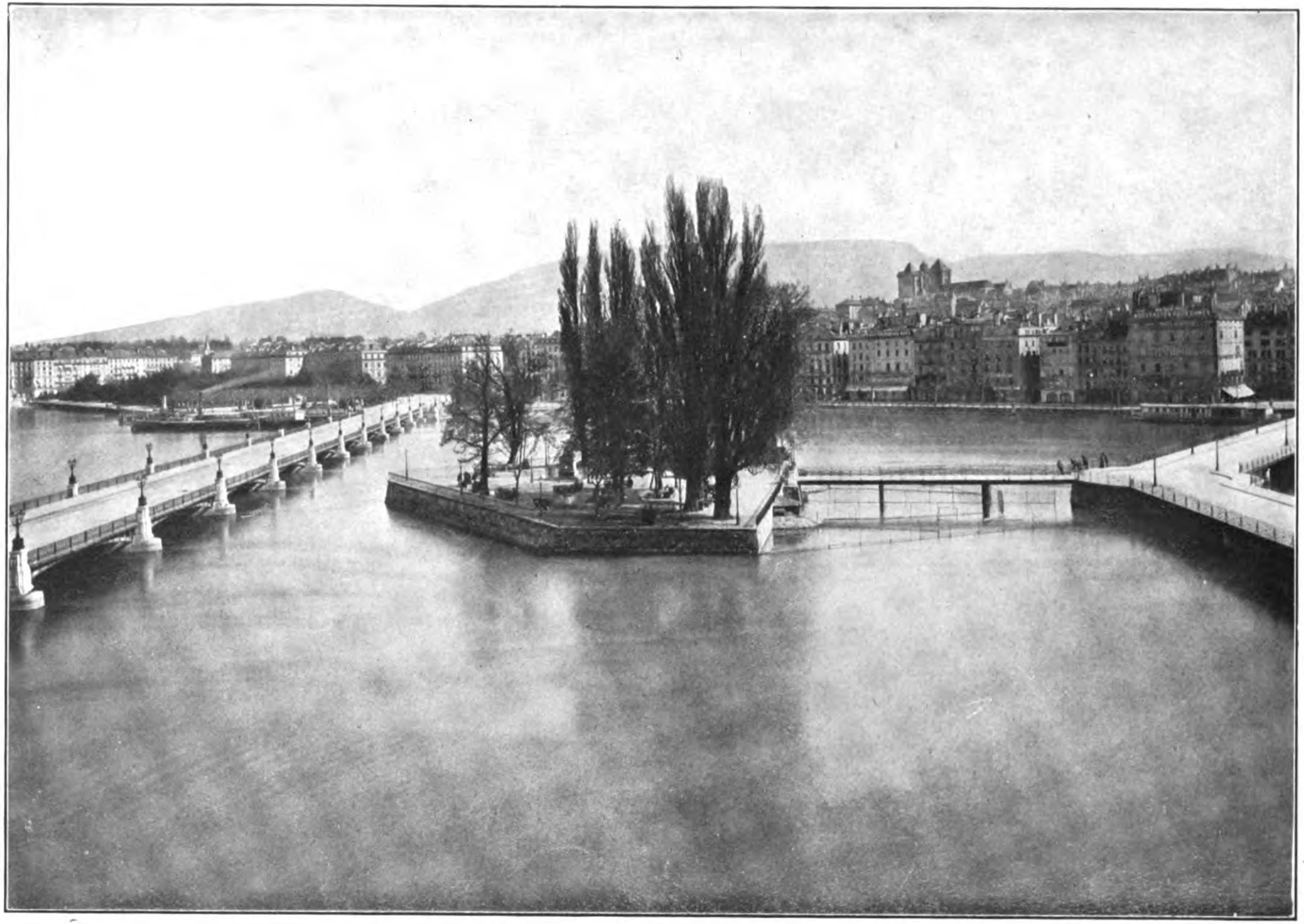
Geneva was a part of the territory of the Allobroges in Cæsar's time, and afterwards part of the Roman Provincia Maxima Sequanorum. The Franks took possession of it in 534 and about three centuries later it was incorporated with the kingdom of Transjurane Burgundy. In 1531 it became a member of the Swiss Confederation. The doctrines of the Reformation were preached here by Farel and were promptly accepted. In 1535 the Reformed religion became the established religion and soon after Calvin was called to Geneva to become public teacher of theology. Through his teaching the town acquired an important influence over the spiritual life of Europe. In the 18th century the city was troubled by continued feuds between the aristocratic and popular parties, until 1782 when France and Sardinia intervened taking the part of the aristocrats. The French Revolution precipitated other troubles; the aristocratic party was overthrown in 1794, equality of all citizens proclaimed, and a reign of terror set in. In 1798 the city and canton became part of France, as Département of Léman. At the Congress of Vienna Geneva again became independent and gained additional territory. During the first three quarters of the 19th century it was the scene of perpetual strife betwen the clericals, conservatives and radicals. The referendum was adopted in 1879 and 12 years later Initiative and Recall were introduced. The final battle between the political factions centred on the separation of Church and state, and resulted in the separation being carried by a referendum in 1907, and the triumph of the progressive parties. In 1912 the canton purchased the central railroad station from the Paris-Lyon-Mediterranée Company of France.

Bibliography.— Blavignac, 'Etudes sur Genève' (Geneva 1872–74); Boissonas 'Genève à travers les siècles' (ib., 1900); Chapuisat, 'La municipalité de Genève pendant la domination française 1798–1814' (2 vols., ib., 1910); Cherbuliez, 'Genève, ses institutions, etc.' (ib., 1868); Galiffe, 'Genève historique et archéologique' (ib., 1869); Pictet de Sergy, 'Genève, origine, etc.' (ib., 1843–47); id., 'Genève ressuscitée' (ib., 1869).

GENEVA, Lake of, or **LAKE LEMAN** (Latin, *Lacus Lemanus*), the largest of the Swiss lakes, extending in the form of a crescent, with its horns pointing south, between France and the cantons of Geneva, Vaud and Valais; length, 55 miles; central breadth, about 6 miles; area 224 square miles; greatest depth, 1,095 feet. It is 1,230 feet above the sea. On the north the shore is low, and the ground behind ascends gradually in beautiful slopes. On the south, and particularly at the east end, the shore is rocky and abrupt, and lofty precipices often rise sheer from the water's edge. It contains various species of fish. The water is remarkably pure and of a beautiful blue color. The Rhône, which enters the eastern extremity, a muddy, turbid stream, issues from the western extremity perfectly pellucid, and likewise of the finest blue. Peculiar phenomena associated with the lake are the so-called "seiches," or fluctuations in the level of the water, caused by sudden alterations in the atmospheric pressure. The *seiches longitudinales* run from one end of the lake to the other; the *seiches transversales* cross from the Swiss to the Savoy side in 10 minutes. Through deposition the lake at its northeast end has contracted considerably. Villages formerly on its shores are now miles inland. The lake has many interesting literary associations; among them with Voltaire, Rousseau, Byron, and the elder Dumas.

GENEVA, University of, a Swiss university founded in 1559, as the Academy of Geneva, and called a university only since 1873. It has about 1,700 students, mostly from abroad, and the principal studies are medicine and philosophy. Women have of recent years been admitted on the same conditions as men. As an academy there were faculties of theology, philosophy, science and law. The theological faculty was the most famous because of the influence of Calvin and Beza, its early directors. After the revocation of the edict of Nantes the university became the centre of French Protestant influence and culture, which it continued to be almost without interruption to the beginning of the 19th century and in a certain degree to the present day. Among the names which have added lustre to the institution are those of Scaliger, Casaubon, De Saussure, Le Sage and De Candolle. Consult Borgeaud, C., 'Histoire de l'Université de Genève' (2 vols., Geneva 1909).

GENEVA ARBITRATION, or **GENEVA AWARD,** the settlement of the Alabama claims by five arbitrators, appointed under the Treaty of Washington (Feb. 1871) by the President of the United States, the Queen of Great Britain, the King of Italy, the President of the Swiss Confederation and the Emperor of Brazil. These rulers, in the above order, named as arbitrators Charles Francis Adams, Lord Chief Justice Sir Alexander Cockburn, Count Federigo Sclopis, Mr. Jacques Staempfli and Baron d'Itajuba. J. C. Bancroft Davis and Lord Tenderden, respectively, represented as agents the United States and Great Britain. The tribunal met at Geneva, Switzerland, 15 Dec. 1871, and Count Sclopis was made presi-



GENEVA, SHOWING MT. BLANC

dent. The United States claimed damages both for direct and for indirect losses, and for injuries occasioned by 13 vessels. The tribunal decided to allow only direct losses caused by the Florida and the Alabama, with their tenders, and by the Shenandoah during part of her cruise. Various rules of international law were laid down which supported most of the contentions of our government. On 14 Sept. 1872, the tribunal "awarded to the United States a sum of $15,500,000 in gold as the indemnity to be paid by Great Britain to the United States as the satisfaction of all the claims referred to the consideration of the tribunal." The British representative cast the only dissenting vote, but Great Britain accepted the decision and paid the award within a year.

GENEVA BIBLE, a translation of the Bible into English, made and published at Geneva, chiefly by English Protestant refugees. It was the first English Bible which adopted the Roman instead of the obsolescent black type, and the first which recognized the division into verses; it was the first also which omitted the Apocrypha. From its stating (Genesis iii, 7) that our first parents made themselves "breeches," it is sometimes called the Breeches Bible. See BIBLE.

GENEVA CATECHISMS, two catechisms in French written by Calvin and published, the larger in 1536 and the smaller in 1541. The latter was subsequently translated into German and Hungarian and adopted as the formulary of the Reformed churches in Switzerland and Hungary.

GENEVA COLLEGE, Pa., a coeducational institution in Beaver Falls, founded in 1848, under the auspices of the Reformed Presbyterian Church; reported at the end of 1915–16: Professors and instructors, 17; students, 425; volumes in the library, 5,000; productive funds, $208,101; grounds and buildings valued at $250,000; income, $28,000.

GENEVA CONVENTION (1864 and 1868), international agreements for mitigating the sufferings of war. The first was initiated by the efforts of two Genevans: a physician named Dunant, who wrote a sickening description of the military hospitals at the battle of Solferino; and a public-spirited citizen named Moynier, who formed societies in various places to urge the neutralization of field ambulances, and called the attention of European governments to it. The majority of these sent representatives to an international conference held at Geneva under the presidency of Gen. William Henry Dufour, the eminent Swiss soldier and statesman. The agreement adopted was signed 22 August; all the European states have since joined in it, and the United States, and several Latin American and Asiatic countries have acceded also. The articles are in substance: (1) Ambulances and military hospitals shall be inviolable while containing sick or wounded; (2) so shall their staff; (3) whether they are occupied by the enemy or not; (4) if the attendants choose to leave the hospitals, they can only take their private property, not the relief appliances, except ambulances and their contents; (5) a house with a sick or wounded soldier shall be neutral and not subject to have soldiers quartered in it, or to requisitions with specific exceptions; (6) the convalesced shall be sent back to their own country under parole for the remainder of the war; (7) hospitals and ambulances, to claim these rights, must carry a uniform flag with a red cross on a white ground as well as their national flag, and the staff must wear a like badge on their arms; (8) special arrangements to be made by the commanders. In 1868 a second convention at Geneva adopted a supplementary convention, to extend the principles of the first to naval warfare, and amplify the first. It provided on the latter point that the medical and surgical staff should receive their regular pay if they remained after occupation by the enemy, and if they left should do so at a time fixed by the commander; that military requisitions should be modified according to the expenditures of the given places in harboring the wounded, and to charities extended toward them; that the paroling home of convalesced soldiers shall not include officers, as they could make their knowledge very serviceable without serving in the field. The marine rules were, that hospital ships, merchant vessels with wounded on board, and boats rescuing men in the water, shall be inviolable, on consideration of carrying their red-cross flag and their crews wearing the red-cross arm badge, that government hospital ships shall be painted white with a green stripe, and private societies white with a red stripe; and that whenever one party in a naval war has sound reason to believe the other is abusing the convention, the first may suspend it till the other proves its honesty, and if proof is not given, may suspend it for the duration of the war. See RED CROSS SOCIETY; WAR.

GENEVIÉVE, zhôn'vē-âv', **Saint,** the patron saint of Paris: b. near Nanterre, Paris, 423; d. Paris, 3 Jan. 512. When yet very young she took a vow of perpetual virginity and subsequently she went to Paris. The city was about to be deserted when Attila with his Huns broke into France; but Geneviève assured the inhabitants of complete security if they would seek it in fervent prayers. Attila took his course from Champagne to Orleans, returned hence into Champagne without touching Paris, and was defeated in 451. By this event Geneviève's reputation was established. In a time of famine she went along the river Seine from city to city, and soon returned with 12 large vessels loaded with grain, which she distributed gratuitously among the sufferers. Her remains were placed in the subterranean chapel which Saint Denis had consecreated to the apostles Paul and Peter. Clovis, by her request, built a church over it, which was afterward called by her name, as was also the abbey founded there. Another church, consecrated to this saint, was built near the church of Notre Dame. By a decree of the National Convention, 1791, this edifice was named the Pantheon, but its original name was restored officially in 1851. Her relics, which were preserved in the former till its destruction at the Revolution, are now in the church of Saint Etienne du Mont. Her fête is held on 3 January. Consult Delalain, 'Life of Saint Geneviève' (Paris 1872); Lesetre, 'Sainte Geneviève' (Paris 1900); Vidieu, 'Vie de Ste. Geneviève' (Paris 1884).

GENEVIÉVE, Saint, duchess of Brabant, wife of Siegfried, count palatine in the reign of Charles Martel (about 750). Being accused by her intendant Golo of adultery during her husband's absence, on his return she was condemned to death; but the vassal to whom her execution was entrusted allowed her to escape, and she lived six years in a cavern upon nothing but herbs. She was finally found, and carried home by her husband, who in the meantime had become convinced of her innocence. This legend is the subject of one of the finest and most perfect of the German popular tales, which appears to have been written by Emmich about 1472. The story has been retold by Tieck and Maler Müller, and dramatized by Raupach.

GENGA, jĕn'gä, **Girolamo,** Italian painter and architect: b. Urbino, 1476; d. 1551. He was for many years a pupil of Luca Signorelli, whom he assisted in numerous pictures, and also of Perugino; painted a 'Resurrection' in the church of Saint Catherine of Siena at Rome; and found a generous patron in the Duke Francesco Maria of Urbino, who finally appointed him court-architect. Among his architectural works were the church of Saint John the Baptist at Pesaro, the restoration of the palace courtyard there, and the bishop's palace of Sinigaglia. With the versatility of the Renaissance, he wrote on the fine arts, and was a musician and sculptor.

GENGHIS KHAN, jĕn'gĭs khän, or **JENGHIS KHAN,** Mongol conqueror: b. near the Onon River, Mongolia, 1162; d. 24 Aug. 1227. His father was chief over 30 or 40 clans, but paid tribute to the Tartar Khan. He succeeded his father when only 14 years of age, and made himself master of the neighboring tribes. A great number of tribes now combined their forces against him and he found himself hard pressed. He found a powerful protector in the great Khan of the Karaite Mongols, Oung, or Ung, who gave him his daughter in marriage; but who ultimately became jealous of his military talents and ordered his assassination, but Genghis made his escape to his own country. Subsequently after much intestine warfare with various Tartar tribes Genghis was proclaimed Khan of the United Mongol and Tartar tribes.

He now professed to have a divine call to conquer the world, and the idea so animated the spirit of his soldiers that they were easily led on to new wars. The country of the Uigurs, in the centre of Tartary, was easily subdued, and Genghis Khan was now master of the greatest part of Tartary. In 1209 he passed the great wall of China, the conquest of which country occupied him more than six years; the capital, Yenking, now Peking, was taken by storm in 1215 and plundered. The murder of the ambassadors whom Genghis Khan had sent to the king of Kharism (now Khiva) occasioned the invasion of Turkestan in 1218 with an army of 700,000 men; and the two cities of Bokhara and Samarcand were stormed, pillaged and burned. Seven years in succession was the conqueror busy in the work of destruction, pillage and subjugation, and extended his ravages to the banks of the Dnieper. In 1225, though more than 60 years old, he marched in person at the head of his whole army against the king of Tangut (northwestern China), who had given shelter to two of his enemies. A great battle was fought, in which the king of Tangut was totally defeated with the loss of 300,000 men. The victor remained some time in his newly subdued provinces, from which he also sent two of his sons to complete the conquest of northern China. At his death which took place in Mongolia, his immense dominions were divided among three of his sons. A great part of the empire, however, came into the hands of Kublai, who is considered as the founder of the Mongol dynasty in China. The only memorial of the conqueror now known to exist is a granite tablet discovered among the ruins of Nertschinsk. The inscription in Mongol has been deciphered by Schmidt of Saint Petersburg. It had been erected by Genghis Khan in commemoration of his conquest of the kingdom of Saratogal (better known as Karakitai). His armies owed their success to their admirable discipline and organization, and to the celerity with which, being mainly horsemen, they moved. Merciless as a conqueror, he nevertheless showed high qualities of statesmanship, and it is said so organized his vast empire that one could travel from one end of it to the other without fear of molestation. Consult Douglas, 'Life of Genghis Khan' (London 1877); Howorth, 'History of the Mongols' (London 1876–88); Johnston, 'Famous Cavalry Leaders' (Boston 1908).

GENGLER, geng'lĕr, **Heinrich Gottfried,** German jurist: b. Bamberg, 1817; d. 1901. He received his education at the universities of Würzburg and Heidelberg, and for over half a century was professor of law at the University of Erlangen. He published 'Das deutsche Privatrecht in seinen Grundzügen für Studierende erörtert' (1856; later ed., 1892); 'Germanische Rechtsdenkmäler' (1875); 'Des Schwabenspiegels Landrechtsbuch' (2d ed., 1875); 'Ueber die deutschen Stadteprivilegien des 16., 17., and 18. Jahrhunderts' (1901).

GENII, jĕ'nĭ-ī, among the Romans, were protecting spirits, who were supposed to accompany every created thing from its origin to its final decay, like a second spiritual self. They belonged not only to men, but to all things animate and inanimate, and more especially to places, and were regarded as effluences of the divinity and worshipped with divine honors among the Romans and Greeks. Not only had every individual his genius, but likewise the whole people had theirs. The statute of the national genius was placed in the vicinity of the Roman forum and is often seen on the coins of Hadrian and Trajan. The genius of an individual was represented by the Romans as a figure in a toga, having the head veiled and the cornucopia or patera in the hands; while local genii appear under the figure of serpents eating fruit set before them. Quite different are the genii whose Arabic name, *Djinn* or *Jinn,* was translated by the Latin term *genius,* for want of a better word, or from the casual similarity of the sounds. The Romans came to believe in evil genii who seem to have been little different from the good genii except in their intentions toward the person to whom each attached himself.

The idea of protecting spirits was not original with the Romans and the Greeks, but has been held by most primitive races. Most of the tribes of American Indians believed that every one had his guardian spirit who played a very important part in his life. In India, Persia and Egypt the belief in guardian spirits was common; and the Mohammedans not only believe in personal guardian spirits but have classified them and given them various ranks and rulers. Christian theology made of the guardian spirit a guardian angel, retaining for the latter practically all the functions and powers of the genii of classical Greek and Roman times. Consult Bekker, 'Le Monde enchante' (Amsterdam 1691); Conway, M. D., 'Demonology and Devil Love' (New York 1889); Thompson, R. C., 'Devils and Evil Spirits of Babylonia' (London 1903). See FAMILIAR SPIRITS.

GENIPAP, a West Indian and South American fruit, which is produced from the *Genipa Americana.* It is a double-cell berry, with numerous seeds, grows to the size of an orange, is greenish-white in color, and has a very agreeable taste. It closely resembles the Cape jasmine.

GENISTA, jē-nis'tạ, a genus of low, branching sometimes spiny shrubs, belonging to the pea family, with usually simple leaves and yellow flowers. There are about 100 species, a few of which are cultivated for ornament. See BROOM; DYE-WEED.

GENITIVE, the name of one of the cases in grammar, which indicates the source or origin of the thing associated with it. For a discussion of the logical notions of case and case endings consult Mauthner 'Zur Grammatik und Logik' (Stuttgart 1913); Paul, 'Prinzipien der Sprachgeschichte' (Halle 1909) and Van Ginneken, 'Principes de linguistique psychologique' (Paris 1907).

GENIUS, in Roman mythology, a tutelary deity. See GENII.

GENIUS OF CHRISTIANITY, The. Chateaubriand's 'Genius of Christianity' ('Le Génie du Christianisme') is a book cardinal in the development of French literature as well as in that of the mind of its author. This becomes clearer if the story 'René' be regarded as an integral part of it, as it was in the book's initial publication. The year of its appearance, 1802, was a turning point also in the moral and political life of the French nation. Its immediate popularity and large influence was chiefly due to the fact that it echoed sentiments that were awaiting some such utterance. It fostered an ethical movement that it did not originate.

The 'Genius of Christianity' appeared at the moment when Napoleon, having attained almost unchallenged power in a France weary of the political disorders and moral negations of revolution, was about to give official recognition and restoration to the chastened national church. France had shown abundant practical evidence since 1796 that it was ready for this act, and Chateaubriand's book served at once as its glorification and its justification. It is a brilliant piece of special pleading for the supreme and unique excellence of traditional Christianity, rigidly logical in form, systematically analytic in the development of its theme, but based rather on what its author called «a rational instinct of submission to all that was beautiful — religion, justice, equality, liberty, glory» than on reasoned dogmatic conviction. To the France of the Consulate he commended Christianity rather because it was beautiful in its works and ways than because it was true in its teachings. In doing this he laid aside neither his pesimism nor even his underlying scepticism, as is clear from his incorporation in the book of the little half-autobiographical story of René, a morbid toying with melancholy. His ambition was rather «to rival Bossuet and ruin Voltaire» than to maintain logical consistency in a mind, made, as he said, «to believe in nothing, not even in itself.»

'The Genius of Christianity' in its four parts, discusses first the dogmas and mysteries of the faith; then, with more zest, its manifestations in poetry, art and literature, and, in the closing section, in worship and ritual. Christianity, the author contends, has more to convince the mind and satisfy the heart than any other faith; it has contributed more to man's æsthetic enjoyments; it has rendered greater services and benefits. The reasoning is often puerile, but the passionate eloquence is still stirring. The doctrine of divine fatherhood is supported by such observations as that «domestic animals are born with just enough instinct to be tamed,» that birds migrate just at the season when they are convenient for human food, and that in French the first syllable of the word for hearthstone (*foyer*) sounds like the word for faith (*foi*). The three Graces of classical mythology are offered as an adumbration of the Trinity, the constellation of the Southern Cross as a witness to the Crucifixion. Not much is gained for Christian apologetics by the discussion «whether the divinities of paganism have poetically a superiority over the Christian divinities,» but there is a stirring emotional appeal in the cumulative contrasts of pagan and Christian fathers, mothers, sons, daughters, priests, soldiers; of Christian poetry and pagan, and especially of the Bible with Homer. Oratorically notable are the descriptive passages, leading the mind through the marvels of nature to the acceptance of Divinity, and the remarkable chapters on Christian Missions and the Eucharistic Sacrifice.

'The Genius of Christianity' was a revindication of the rights of sentiment from the materialism of the encyclopædists and the *philosophes.* Thus it contributed essentially not only to the re-establishment of Roman Catholicism in France but to the approaching revival of the more personal forms of writing, especially of lyric poetry and of introspective prose, that literature of «confessions,» of whose morbidity René was the prototype, which was so characteristic of the young Romantic School. The 'Genius of Christianity' has been translated and edited by C. L. White, and selections from it under the title 'Spirit and Beauty of the Christian Religion' by E. B. Stork. Consult also Sainte Beuve, 'Chateaubriand et son groupe littéraire sous l'empire' (2 vols., 1861).

BENJAMIN W. WELLS,
Author of 'Modern French Literature.'

GENLIS, zhŏn'lēs', **Stéphanie Félicité Ducrest de St.-Aubin,** COMTESSE DE, French writer: b. Champceri, Burgundy, 25 Jan. 1746;

d. Paris, 31 Dec. 1830. At the age of 16 she was married to the Comte de Genlis, and in 1770 was made lady-in-waiting to the Duchesse de Chartres. In 1782 the Duc de Chartres, afterward known as Egalité, appointed her "governor" of his children, including Louis-Philippe. She wrote a variety of works for her pupils, among others: 'Theatre of Education' (1779–80), a collection of short comedies; 'Annals of Virtue' (1781); 'Adèle and Theodore, or Letters on Education' (1782); 'The Virgils of the Château' (1784). On the breaking out of the Revolution she took the liberal side, but was ultimately compelled to seek refuge (1793) in Switzerland and Germany. When Bonaparte became consul she returned (1799) to Paris and received from him a pension. Her writings fill some 90 volumes. Among them are 'Précis de la Conduite de Madame de Genlis' (1795); 'Chevaliers du Cygne' (1795); 'Madame de la Vallière'; the romance, 'Mademoiselle de Clermont' (1802); 'Memoirs' (1825); Baron d'Holbach's Dinners.' The last contains a great deal of curious but malicious information concerning the freethinkers of the 18th century. Consult Bearne, C. M., 'Heroines of French Society' (New York 1907); Chaband, L., 'Les précurseurs du féminisme' (Paris 1901); Harmand, J., 'A Keeper of Royal Secrets' (London 1913); Sainte-Beuve, 'Causeries' (Vol. III, Paris 1857).

GENNADIUS, Greek patriarch of Constantinople: b. about 1400; d. 1478. In secular life he was known as George Scholarius. He visited the Council of Florence with John Palæologus in 1439, where he tried to bring about a union of the Eastern and Western churches. After his return to Constantinople he became a monk and in 1453, after the capture of the city by the Turks, he was chosen patriarch.. At the request of the invaders he drew up a confession of faith, which is a complete exposition of the doctrines of the Greek church. Gennadius resigned his high office in 1459 and retired to a monastery. He wrote many works, few of which have been published. Consult Schaff, 'Creeds of Christendom' (4th ed., 3 vols., New York 1905). For some of Gennadius' works consult Migne's 'Patrology' (Vol. CLX, Paris 1856).

GENNESARET, jĕ-nĕs'ą-rĕt, **LAKE** or **SEA.** See GALILEE, SEA OF.

GENOA, jĕn'ō-ą (ancient GENUA), Italy, a fortified city, situated on the Gulf of Genoa, at the foot of the Apennines, on the Bisagno River, the capital of the province and the most important seaport. While worthy of its title, "Genoa the Superb," as viewed from the sea, it is in reality built awkwardly on irregular rising ground, and consists of a labyrinth of narrow and intricate streets. Of the palaces the most famous are the ducal palace formerly inhabited by the Doges, now appropriated to the meetings of the senate; and the Doria, presented in 1529 to the great Genoese citizen Andrea Doria, whose residence it was during his presidency of the republic. The palaces Brignole-Sale, Reale, Durazzo-Pallavicini, Spinola, Balbi-Senarega, and others possess great interest on account of their historical fame and architectural beauty. Many of them contain galleries of paintings: the Brignole-Sale has works by Van Dyck, Rubens, Albrecht Dürer, Paolo Veronese, Guercino, etc. Among the churches are the Cathedral of Saint Lorenzo, in the Italian Gothic style; the Church of Saint Ambrogio (1589), containing pictures by Guido Reni and Rubens. The marble municipal palace, built in the Late Renaissance style, with a magnificent vestibule, courtyard and galleries, and the palace of the Dogana must also be mentioned. Genoa has a university, founded in 1243, a library of 116,000 volumes; also numerous technical schools, and institutions of higher education. The hospital, the asylum for the poor (capacity 2,200), the deaf and dumb institution, and the hospital for the insane are among the finest institutions of their kind in Italy. There are numerous excellent philanthropic foundations, as the Fieschi, an asylum for female orphans. The public library contains 50,000 volumes; and there are the Academy of Fine Arts, founded (1751) by the Doria family; the Carlo Felice Theatre, one of the finest in Italy: and the Verdi Institute of Music. Genoa is the commercial outlet of a wide extent of country, of which the chief exports are rice, wine, olive oil, silk goods, coral, paper, macaroni and marble. The imports are principally raw cotton, wheat, sugar, coal, hides, coffee, raw wool, fish, petroleum, iron, machinery and cotton and woolen textiles. The total commerce in 1912 amounted to $306,-140,000. The imports equalled $207,680,100; and the exports $98,360,000. The chief imports were coal, about $20,000,000; wheat, $25,310,-000; cotton, about $44,000,000; metals, $24,000,-000. The manufactures are velvet and silk fabrics, woolen goods, cotton goods, ribbons, damask, embroidery, artificial flowers, hats, paper, leather and leather goods, furniture, objects in gold, silver, ivory, marble, alabaster and coral, essences, soap, preserved fruits, chocolates, macaroni and vermicelli. There are also several flour mills. The harbor has an area of over 600 acres, and consists of the Porto, with a depth of 19 feet, the Porto Nuovo with 32 feet of water, and the Avamporto with 45 feet of water. There is an elaborate system of quays, floating docks, etc. The improvements to the harbor began in 1877 and were completed at a cost of $12,000,000 in 1895.

The history of Genoa may be traced back in legendary traditions to a time preceding the foundation of Rome. It was one of the most considerable cities of the Ligurians, and is mentioned by Livy (under the name of Genua) as being in friendly relations with Rome at the beginning of the second Punic war. It was subdued and partly destroyed during that war by a Carthaginian fleet under the command of Mago. The Romans rebuilt it, and it afterward became a Roman municipium. After the decline of the Roman empire in the West it fell into the hands of the Lombards, and with them became subject to the Franks. After the downfall of the empire of Charlemagne, Genoa erected itself into a republic, and till the 11th century shared the fortunes of the cities of Lombardy.

If Genoa had adopted a wise colonial system she would have held the first rank among the commercial nations at the end of the Middle Ages. After the conquest of Constantinople by Mohammed II in 1453, the Genoese soon suffered for the aid they had imprudently afforded the Turks. Mohammed took from them their settlements on the Black Sea in 1475, and at length all access to this branch of trade was denied them by the Turks.

While the power and commercial rank of Genoa were attaining their height by means of their foreign trade and acquisitions of territory the city was internally convulsed by civil discord and party spirit. The hostility of the democrats and aristocrats and the different parties among the latter occasioned continual disorders. In 1339 a chief magistrate, the Doge, was elected for life by the people, but he had not sufficient influence to reconcile the contending parties. A council was appointed to aid him; yet after all attempts to restore order to the state, there was no internal tranquillity; indeed, the city sometimes submitted to a foreign yoke in order to get rid of the disastrous anarchy which the conflict of parties produced.

In 1528 the disturbed state regained tranquillity and order which lasted till the end of the 18th century. The form of government established was a strict aristocracy. The doge was elected to be the head of the state. The nobility were divided into two classes — the old and new. To the old belonged, besides the families of Grimaldi, Fieschi, Doria, Spinola, 24 others who stood nearest them in age, wealth and consequence. The new nobility comprised 437 families. The doge might be taken from the old or new nobles.

Little by little Genoa lost all her foreign possessions. Corsica, the last of all, revolted in 1730 and was ceded in 1768 to France. When the neighboring countries submitted to the French in 1797 the neutrality which the republic had strictly observed did not save the fluctuating government from ruin. Bonaparte gave to them a new constitution formed on the principles of the French representative system. Two years afterward a portion of the Genoese territory fell into the hands of the Austrians; but the fate of Genoa was decided by the battle of Marengo. A provisional government was established, and in 1802 it received a new constitution as the Ligurian republic and acquired some increase of territory, and had in 1804 a population exceeding 600,000. Its naval force, which was so formidable in the Middle Ages, at last dwindled down to a few gallevs and barques; the land force became almost equally insignificant.

On the overthrow of the French empire Genoa was occupied by the British with whose permission the ancient constitution was re-established. But the Congress of Vienna in 1815 assigned Genoa with its territories to Sardinia, stipulating that it should have a sort of representative constitution. In 1821 it joined for a moment the revolutionary movements of Italy. In the spring of 1849, after the defeat of Charles Albert of Novara and the conclusion of a truce with the Austrians, a revolutionary outbreak took place, the national guards occupied the forts, and the garrison was compelled to withdraw. A provisional government was formed and the independence of the republic was proclaimed. But a large body of Sardinian troops under Gen. Della Marmora, soon appeared before the city; a bloodv struggle ensued and the forts and principal points of the city were taken by the royal soldiery. Meanwhile a deputation was sent to Turin, which returned with the amnesty of the King, excluding the chief leaders of the movement, who, however, escaped on board an American vessel. In April the city was disarmed and the monarchical government restored. Following the fortunes of the Sardinian states, Genoa became a portion of the kingdom of Italy. Pop. 272,221. Consult Bent, 'Genoa: How the Republic Rose and Fell' (London 1881); Canale, 'Nuova Istoria della Republica di Genova' (4 vols., Florence 1858-64); Carden, 'The City of Genoa' (New York 1908); Duffy, 'The Tuscan Republics, with Genoa' (ib. 1893); Mallison, 'Studies from Genoese History' (London 1875); Staley, 'Heroines of Genoa and the Rivieras' (New York 1911).

GENOA, Bank of. The organization known to economic works as the Bank of Genoa was not originally a bank. In the 12th century it consisted of a group of enterprising persons connected with the cathedral and see of Genoa, who had the address to engage the military forces of the republic in the plunder of Saracenic Spain. At that period Genoa had secured a footing in the Balearic Isles, an advantageous base for such operations against the Moors as in a future age Cortes and Pizarro conducted against the Mexicans and Peruvians.

Says Anderson in his 'History of Commerce': "The Genoese were frequently instigated against the Moors of Spain. In 1136, with 153 ships and 60 galleys, aided by large land forces, they took Almeria with great slaughter and a vast booty. In 1137 they assembled their forces at Barcelona and were equally successful in the reduction of Tortosa."

The envoys, promoters, or speculators who initiated and incited these enterprises advanced to the Genoese Republic the pecuniary means to carry them out, upon condition, however, of being repaid in treasury bills secured by pledges of certain Genoese revenues and the further condition that such bills should be receivable as money at public sales of captured property and of taxed farms, or as right to collect the public revenues. Thus the state was induced to supply men, ships and munitions of war for these expeditions and to reward the promoters, who risked nothing, with the coveted privilege of being preferred creditors and bidders at the sales of spoil and tax-farms. Armed with these advantages, treated as preferred and favored creditors, they became, says Anderson, the richest citizens of Genoa, with "most of the cities and territories pawned, or rather sold to them, which terrains this Society (of San Giorgio) governed and defended. Machiavel was of opinion that in time this bank (of San Giorgio) would get possession of the whole city and republic." This is precisely what happened: the bank absorbed the republic.

The treasury bills issued by the republic for the advances made by the speculators, were called *mahonas,* probably after Port Mahon in the Balearics, whence the earlier expeditions sailed. Increased caution on the part of the Moors, the resulting scarcity of spoil, an expensive and fruitless war with Aragon, the destructive feuds of the Guelphs and Ghibellines and other circumstances, rendering Genoa unable to meet the outstanding certificates upon their maturity, the republic was fain to offer still further advantages to the bill-holders, who with the view to make the most of such advantages, assembled 1345 and organized 1346 as The Compera di San Giorgio, their certificates taking the name of comperas (purchasers) probably in allusion to their legal attribute of purchasing any spoil or tax-farm offered at public sale.

After the drained and impoverished republic had fallen into the arms of France (reign of Charles VI), the Compera was reorganized by Marshal Boucicaut, 2 March 1408, as the Ufficio di San Giorgio, with a capital consisting of the outstanding *comperas.*

RIGHTS AND PRIVILEGES CEDED TO THE BANKS.

A. D.
1417. Right to prescribe public laws, civil or criminal.
Right to apply the *jus gladii*, or penalty of death in all matters relating to the bank.
Right to establish exclusive and appellate tribunals and to appoint the judges.
1420. Privilege of being legally regarded as first mortgagee of all property, real or personal, of every individual indebted to the bank.
1425. Passports of departure from the state declared void as to persons indebted to the bank.
1453. Right to compel the doge or other executive of the State to swear upon his inauguration to maintain the privileges of the bank.
The "loughi" (shares in the bank) declared to be inviolable, and exempt from taxes, attachment, seizure or any other process of law.
1463. Right to invoke the power of ecclesiastical excommunication against all refractory debtors to the bank, clergymen as well as laymen.
1539. Seventy-six branches of the public revenue pledged to the bank forever.
All existing *compere* declared unredeemable and perpetual. (Del Mar, "Politics of Money").

The restrictions imposed upon their avidity by Marshal Boucicaut only lasted long enough for the influential proprietors to make suitable representations at Rome; when the marshal was removed and the process of absorbing the republic was resumed by the Ufficio, until the great events of the 16th century, the discovery of America by Columbus, the Protestant Reformation by Luther and the consolidation of the German Empire by Charles V confronted the Ufficio with foreign complications concerning which only a sovereign state was competent to deal. Hence the republic of Genoa was now once more enabled to raise its head; and after a long and vexatious process of reaction, the ambitious Ufficio was finally reduced to the modern condition of a bank, subject to the state and amenable to its laws. This conversion is usually assigned to the year 1673.

Although the Compera of 1346 and the Ufficio of 1408 had both, on certain critical occasions, stopped payment, the bank of 1673 had no such bar sinister in its escutcheon. It was practically a new organization, of ample capital and excellent connections both in Italy and the northern countries. On the other hand a new order of public affairs had arisen in which Genoa played but a very insignificant part, a fact that the Florentine navigator Vespucci lays great stress upon. The oriental trade of Genoa was lost, its Mediterranean trade was divided and dispersed among several rivals. The textile trades formerly largely engrossed in the Levant and Italy had found more favorable conditions in England, Flanders and the German states; while new empires had arisen in Spain and Portugal, with rich trades in America and the Orient, in none of which could Genoa now hope to take part.

The bank of Genoa (properly the Bank of San Giorgio) received money on deposit, allowing interest for the same. It paid out money upon the presentation of warrants, bills of exchange and orders (cheques); it discounted commercial paper; it issued bills of exchange payable in distant cities; it dealt in uncurrent coins; it also acted as negotiant, or umpire, or referee, in the matter of certain foreign claims upon Genoa for damages at sea. The promotion of companies to despoil the Spanish Moors and Jews, as organized under the Compera, seems to have been abandoned for lack of material. The commercial agency established by the Ufficio was continued by the bank and proved very useful to merchants both in Genoa and elsewhere. Genoa struck its first gold coin, the genovina (ducat) in 1252. From that time onward numerous changes of the ratio between gold and silver coins were made by the Compera and Ufficio, both of whom in turn had control of the mint. To the monetary confusion thus created the bank of 1673 contributed a further source of dispute. It instituted distinctions between moneta permesso, moneta di paghe and moneta cartularo, from which the profit was small in proportion as the public vexation was great. The republic was dead; and the bank, still living on its remains, was finally extinguished by Napoleon in 1797. For the history of other ancient banks, see BARCELONA, BANK OF; BYZANTIUM, BANK OF FUGGERS, BANK OF THE; MEDICI, BANKS OF THE; TYRE, BANK OF; VENICE, BANK OF.

GENOA, Gulf of, a large indentation in the north shore of the Mediterranean, north of Corsica, having between the towns of Oneglia and Spezia a width of nearly 90 miles.

GENOUDE, zha'nood', **Antoine Eugène,** French publicist: b. Montélimar, Drôme, 1792; d. 1849. He studied philosophy, subsequently became a devout Catholic and supporter of the Bourbon dynasty. He was a pioneer advocate of universal suffrage; founded *Le Défenseur* in 1820, which was followed a year later by *L'Etoile.* In 1825 he revived the *Gazette de France.* After 1830 he attacked the new party. In 1835 he took holy orders and in 1846 became a member of the Chamber of Deputies. He published 'Voyage dans la Vendée et dans le midi de la France' (1820); 'La raison du christianisme' (1835); 'Histoire de France' (16 vols., 1844–47), and a translation of the Church Fathers to 300 A.D.

GENOUILLERE, zhą'noo'yär', in fortification, a part of the interior slope of a parapet which covers the lower portion of a gun carriage. See FORTIFICATION.

GENOVESI, jä'nō-vä'sē, **Antonio,** Italian philosopher and political economist: b. 1712; d. 1769. With a view of entering the ministry of the Church he began the study of theology in a monastery, took holy orders and became professor of rhetoric at Salerno. He soon became dissatisfied with his position, went to Rome, studied law and was admitted to practice as an advocate. Later he abandoned this profession also and devoted his attention to philosophy. In the University of Naples he was made extraordinary professor of philosophy and opened a private college. In 1743 he published his 'Elements of Metaphysics,' and his 'Logic' appeared two years later. His discussions of metaphysics involved him in difficulties with the authorities and not without difficulty did he obtain the chair of moral philosophy and that of theology was later denied him. Despite the opposition to Genovesi on the part of the Scholastics Benedict XIV, several cardinals and many learned men approved his course. Genovesi became first professor of political economy at Naples, in which he was the first to use Italian in the lecture room. He wrote 'Lezioni di commercio o sia economica civile' (1765). His 'Opera scelte' in four volumes was issued at Milan in 1835. Consult Bobba, 'Commemorazione di A. Genovesi' (Benevento 1867).

GENRE (zhŏn-r) **PAINTING,** in art, from the French *genre* (sort or kind), which was originally employed to designate pictures of which the subjects were copied directly from nature, such as landscapes, scenes of every-day life, animals, fruit, and even portraits; in contradistinction to those which were more the product of the imagination, such as historical, religious, and purely ideal paintings. The term is now restricted to denote scenes of every-day life, such as Hogarth and Wilkie loved to depict. A genre painter is not confined to low subjects, nor need his paintings be vulgar in the ordinary acceptation of the word, though the great modern masters in this style, the Dutch, have owed their inspiration and fame to scenes of very humble and often coarse life. In short the human element is the dominant note in genre painting. This style of painting was not unknown to the ancients. Pyreicus, a Greek painter of the time of Alexander the Great, painted barbers' shops, cobblers' stalls, and the like, and according to Pliny, his pictures were highly prized. Genre painting had become popular in the late Greek and Roman periods, and the excavation of ancient classical cities has brought to light numerous fine examples of the work of the artists of these later classical periods. In Italy the painters who have worked in this style are Caravaggio, Manfredi, Salvator Rosa, Benedetto Castiglione, etc. But the art received its highest development in the Netherlands; Teniers the younger, Jan Van Mill, D. Ryckaest, Rembrandt, Nicholas Maas, Gerard Dow, Jan Steen, the Van Ostades, Brauwer and Bega, are among the best exponents of the style. In Great Britain, after Hogarth and Wilkie, already mentioned, come Leslie, Mulready, Maclise, Egg, Millais, Faed and others. The British school has sought to lend a dignity to the style by the introduction of the dramatic element. But genre painting has never been neglected in any of the European countries since the days of the early Netherland masters who depicted every phase of the life in which they lived. In the 18th century the French artists carried out the traditions of the genre masters and elaborated them in their own distinctly national way. Among these who acquired an international reputation were Boucher, Chardin, Fragonard and Lancret. Since then France has never lacked genre painters. Bargue, Meissonier, Roybet and Vibert were brilliant exponents of the art in the middle of the 19th century; and they had many followers and imitators. See PAINTING.

GENS, among the Romans, denoted that those persons belonged to the same *gens* who bore the same name; were born of freemen; had no slave among their ancestors; and who had not been reduced from a superior to an inferior condition. The gens consisted of many families, supposedly of kindred blood, but was also applied to a whole community, the members of which were believed to be descended from a common stem. Consult Lange, 'Römische Alterthümer' (3 vols., Berlin 1877).

GENSERIC, jen'sĕr-ĭk, or **GAISERIC,** king of the Vandals: b. about 400; d. 477 A.D. He was a natural son of Godigisdus, the great leader of the Vandals when they overran Spain. Goderic succeeded the latter as ruler of the conquered territory; and on his death Genseric, who had shown special capabilities as a ruler of men, became king. An invitation in 429 from Boniface, Count of Africa, viceroy under Valentinian III, to come and help him against his rival Aetius, gave him a chance to display his military ability. Genseric landed in Africa with 50,000 men and swept everything before him in Mauritania, where the natives flocked to his standard. Boniface realizing that he had made a mistake in inviting the terrible leader of the Vandals to aid him, hastily attempted to organize his forces to oppose him. Twice defeated he was finally driven into the mountains and slain, and all northern Africa from Carthage westward, and finally the latter city, surrendered to Genseric who extended his conquests to parts of the islands of Sicily, Sardinia, and Corsica. He made Carthage the capital of this new empire in 439. In 455, on the invitation of the Empress Eudoxia, Valentinian's widow, who sought his assistance against Maximus, the murderer of her husband, he landed at Ostia and marched to Rome, which he stormed and gave up to pillage for 14 days. On his departure he carried off the empress herself and her two daughters, one of whom he married to his son Huneric. Two attempts on the part of the empire to shake off the rule of Genseric were unsuccessful. The western emperor Majorian sent a great fleet against the Vandals in 457. This Genseric met and destroyed in the Bay of Carthage. A similar attempt on the part of the Eastern Emperor Leo, in 468, met with a like fate at Bona. Thus, under Genseric, the Vandals became as formidable on sea as they had become on land. Consult Gibbon, 'Decline and Fall of the Roman Empire'; Hodgkin, 'Italy and her Invaders' (1892–95); Martroye, 'Genseric: La Conquête vandale en Afrique' (Paris 1907); 'Cambridge Mediæval History' (New York 1911).

GENSFLEISCH, gens'flīsh. See GUTENBERG, JOHANNES.

GENSICHEN, gĕn'sik-en, **Otto Franz,** German author: b. Driesen, Prussia, 1847. He received his education at the University of Berlin; from 1874 to 1878 was engaged as dramaturgist at the Wallner Theatre, Berlin. After 1878 he devoted himself exclusively to literary work. He published 'Gedichte' (2d ed., 1871); 'Vom Deutschen Kaiser' (4th ed., 1871); 'Felicia' (16th ed., 1882); 'Robespierre' (1873); 'Phryne' (1878); 'Jungbrunnen' (1901); 'Blutschuld' (1905).

GENSONNÉ, zhäṅ'sŏ'nā', **Armand,** French politician: b. Bordeaux, 1758; d. 1793. He was elected to the Legislative Assembly from the Gironde and subsequently served as commissioner to La Vendée. He proposed the law of

31 Dec. 1791 in which several accusations were hurled at the brothers of the king and members of the aristocracy. Many other projects were introduced by him, especially that confiscating the property of the *emigrés*. In March 1793 he presided over the National Convention, but in the following June he was thrown into prison, was tried on a charge of treason in October and was executed with other Girondists on the 31st of the same month.

GENTH, Frederick Augustus, American chemist: b. Wächtersbach, Hesse, 1820; d. 1893. He received his education at the University of Heidelberg, and also at other German seats of learning. In 1845–48 he was assistant to the celebrated Bunsen. In 1848 he came to Philadelphia and organized an analytical laboratory. He became professor of chemistry at the University of Pennsylvania in 1872, resigned in 1888, and re-established his laboratory. He wrote much on chemistry and mineralogy and isolated about 23 new minerals. His published works include 'Researches on the Ammonia-Cobalt Bases' (1856); 'Corundum' (in 'American Philosophical Society Proceedings,' 1873), and reports while employed as mineralogist of the Geological Survey of Pennsylvania.

GENTH, Lillian Mathilde, American artist: b. Philadelphia, 1876. She studied art at the Pennsylvania School of Design for Women, and under Whistler at Paris. She returned to her native land in 1903. She painted many female nudes with landscape backgrounds and also several portraits in which she became very popular. She was awarded the Mary Smith prize in 1904, the Shaw memorial prize in 1907 and the Hallgarten prize of the National Academy in 1911. She is represented in the National Gallery, Washington, the Carnegie Institute, Pittsburgh, the Brooklyn Institute Museum, and the Metropolitan Museum, New York.

GENTHITE, a hydrous nickel-magnesium silicate, $2NiO2MgO3SiO_2 6H_2O$, but nickel content is variable. It occurs at Nickel Mountain near Riddle, Ore., also in Towns County, Ga.

GENTIAN, a genus, *Gentiana,* of plants of the family *Gentianaceæ*. More than 300 species are known, distributed throughout the temperate and mountainous regions of the world. Most of the species have blue flowers and many are celebrated for their beauty. In eastern North America the best known species are the fringed gentian, *G. crinita,* soapwort gentian, *G. saponaria,* and *G. andrewsii,* closed gentian, but many other species occur, scattered nearly throughout the continent.

In pharmacy gentian is the dried rhizome and root of *Gentiana lutea*. This is the yellow gentian of Europe, a tall mountain perennial, growing abundantly in southern and middle Europe and Asia Minor. The chief sources of supply to the drug market are Switzerland, southern France, and the hilly portions of Germany. The main constituent of the root is a bitter glycoside, gentiopicrin. It also contains sugar, gums, and salts. The action of gentian is that of a simple bitter and it is used to improve the appetite and thus secondarily affect the general constitution.

GENTILE, Da Fabriano. See FABRIANO, GENTILE DA.

GENTILES (Latin *gentilis,* from *gens,* a tribe, clan or family), originally used by the Jews to signify non-Israelitic peoples. It is used to signify, in Scripture, all the nations of the world, excepting the Jews. In the Old Testament it is the rendering of the Hebrew word *goim,* peoples, nations, the plural of *goi,* a nation, a people. At first it was used as a mere ethnological word, and quite respectfully, but as the Jews became more conscious of their privileges they employed it more and more scornfully of the nations around (Gen. x, 5; Isa. lxvi, 19; Jer. xiv, 22). This attitude was especially noticeable after the occupancy of Canaan and the growth of Hebrew national spirit and power; and it was due, in part at least, to the fierce and frequent struggles with the surrounding nations, which had early taken on a semi-religious, semi-political complexion which tended to increase among the Jews the feeling that they were a race peculiarly favored by the Lord of Hosts and the God of Gods. In the New Testament Gentiles is the rendering of the Greek *ethne,* the plural of *ethnos,* a number of people living together, a nation. Saint Peter, moved by a vision, was the first of the Twelve to preach to the Gentiles (Acts x); but the Apostle of the Gentiles was Saint Paul (Gal. ii, 15). Jewish law divided the Gentile residents in Palestine into two classes, the permanent (*ger*), resident and stranger (within the gates, *zar*). The former had numerous privileges which the latter did not have; in fact they had some privileges not accorded to the Jews, as, for instance, the removal of certain food restrictions. In the course of time the idea that the Jewish people constituted a specially and divinely privileged people, a sort of holy entity, created peculiar relations between them and the Gentiles who were consequently looked upon as unholy, and as, therefore, the inferior of the Jews. They could not therefore, be met by the latter as equals. This attitude accounts for the fact that the Jew has ever since retained his racial characteristics wherever he has preserved his religious faith. See BARBARIAN; PHILISTINES; ISRAEL.

Consult Bertholet, 'Die Stettung der Israeliten und der Juden zu den Fremden' (1896); Farrar, 'Saint Paul'; Josephus, 'History of the Jewish War'; Oehler, 'Old Testament Theology'; Pfleiderer, 'Paulinismus': Schultz, 'Old Testament Theology'; Scheurer, 'Ancient Hebrew Tradition'; Tacitus, 'Histories'; French, 'New Testament Synonims'; Weiss, 'New Testament Theology'; Weizäcker, 'The Apostolic Age.'

GENTILESSE, jĕn'tĭ-lĕs', a poem by Geoffrey Chaucer, preserved in a "morale balade" of Henry Scogan. The entire ballad has appeared in all editions of Chaucer, although as early as the 15th century John Shirley recognized the interpolation. In Skeat's edition the part by Chaucer was for the first time printed separately. Scogan was a disciple and admirer of Chaucer.

GENTILI, Alberico, Italian-English jurist. founder of the science of international law: b. Sanginesio, 14 Jan. 1552; d. London. 19 June 1608. He was educated at the University of Perugia, where he received the degree of doctor juris civilis. For a short time he held a judicial office at Ascoli, after which he returned to Sanginesio and set about recasting its ordinances. His Protestant opinions obliged him to seek refuge in Carniola. He was designated as contumacious by the Inquisition and he soon had to quit Austrian territory. In 1580 he settled at Oxford and soon afterward began to lecture on Roman law. In 1587 he was appointed regius professor of civil law at Oxford University. His lectures and commentaries greatly enhanced his reputation as a jurist, especially his application of old legal maxims to the then new problems arising from the growing intercourse between nations. In 1584 Gentili was consulted by the English government in the Mendoza case. The latter, while Ambassador of Spain to the court of Elizabeth, had been discovered plotting against her. Gentili later expanded his answer in the work, 'De legationibus libri tres.' A treatise on the law of war ('De jure belli commentatio prima') appeared in 1588, and was subsequently expanded to 'De jure belli libri tres' (1598). He was admitted member of Gray's Inn in 1600, and five years later became counsel to the king of Spain. The 'Libri duo Hispanicæ advocationis' contains the record of his work in this service. Not until the last quarter of the 19th century did the world assign Gentili his true place as the first to define adequately the relations of states and to indicate the solution of international problems according to the principles of natural law and the common sense of mankind, without regard to precedent or the still more hampering rules of the Church. A monument to Gentili was erected in England in 1877 and in 1908, on the tercentenary of his death, a statue of him was unveiled in his native city. Consult Holland, T. E., 'Studies in International Law' (1898) and Walker, T. A., 'History of the Law of Nations' (Vol. I, 1899).

GENTILLY, zhän'tē'yē', France, town in the department of the Seine, about two miles south of Paris, of which the city wall divides the town into Great and Little Gentilly. It contains a 13th century church, potteries, chemical works, tanneries, etc. Pop. 11,000.

GENTLE. See FLESH FLY.

GENTLEMAN DANCING-MASTER, The, a comedy of Wycherley (q.v.). It first saw the light in 1671.

GENTLEMEN-AT-ARMS, a bodyguard of the king of England, of which the full designation runs «His Majesty's Bodyguard of the Honorable Corps of Gentlemen-at-Arms.» It was instituted by Henry VIII in 1509 and was at first called «Speers,» and later «Gentlemen Pensioners.» Its present designation dates from 1834. It is the second oldest corps in the British service and does duty only at drawing rooms, levées and other important functions. The Crown appoints the members from among military officers of distinction on the retired list and on the recommendation of the commander-in-chief. The captaincy of the corps is vacated with each ministry.

GENTOO, corrupt form of the Portuguese *gentio*, heathen, which was formerly employed to designate some peoples of India, especially the Telugu.

GENTZ, Friedrich von, German statesman: b. Breslau, 1764; d. 1832. He was educated at Frankfort and Königsberg and in 1786 was appointed secretary of the General Directory and in 1793 became war councilor of Prussia. At first a follower of Rousseau and Kant he was in favor of the great popular movement in France, but was soon diverted from this course by the writings of Burke, Mallet du Pan and Mounier. A stay in England made him a strong advocate of the constitutional system of that country. He founded the *Neue Deutsche Monatsschrift* in 1795 and after its demise in 1798 the *Historisches Journal*. In the latter he attacked the Revolution so persistently that he was obliged to leave the country. In 1802 he became Imperial councilor in Austria and bitterly opposed Napoleon. He wrote several proclamations against the French. Subsequently he supported Metternich's policy and in 1818 founded the *Wiener Jahrbücher der Litteratur*. In 1815 he served as secretary to the Austrian plenipotentiaries at the Congress of Vienna and at the subsequent conferences of Aix-la-Chapelle, Troppau, Laibach, and Verona. He led a dissipated life and squandered his substance. His motives were seldom pure and were nearly always mercenary. His writings are contained in 'Ausgewählte Schriften' edited by Weickz (5 vols., Stuttgart 1838) and in 'Kleine Schriften' edited by Schlesier (5 vols., Mannheim 1840) and in 'Mémoires et lettres' edited by Prokesch-Osten (4 vols., Vienna 1874). Consult 'Briefwechsel zwischen Friedrich Gentz und Adam Müller 1800–29' (Stuttgart 1857); 'Dépêches inédites du Chevalier de Gentz aux hospodars de Valachie 1819–28' (Paris 1876); Fournier, 'Gentz und Cobenzl' (Vienna 1880); Reiff, 'Friedrich Gentz, an opponent of the French Revolution and Napoleon' (Urbana, Ill., 1912); Lüblee, 'Friedrich Gentz und Heinrich von Sybil' (Göttingen 1913).

GENTZ, Wilhelm Karl, vĭl'hĕlm kärl gĕnts, German painter: b. Neuruppin, Brandenburg, 9 Dec. 1822; d. Berlin, 23 Aug. 1890. He traveled in Spain, Morocco, and Egypt, depicted Oriental civilization and the life of the desert with increasing insight and success, and at first turned his attention to the rendering of biblical scenes in the spirit of the actual East. Of the works of this period are 'Christ in the House of Simon'; 'Christ among the Pharisees and Publicans.' Despite the skill with which he rendered the brilliant light effects peculiar to those regions, his work was slow in making its way. Ultimately, however, he was ranked not at all inferior to the most distinguished French colorists. He was a professor in the Berlin Academy, from 1877 a member of the Senate; and obtained the great medals of Berlin (1866), Vienna (1873) and Munich (1876). In 1873 he visited Palestine to make local studies for his greatest achievement, 'Entry of the German Crown Prince into Jerusalem, 1869,' which was completed in 1876 and hung in the National Gallery of Berlin. Other of his canvases are 'Mecca Caravan at Prayer'; 'Meeting of Two Caravans in the Desert'; 'Evening on the Nile'; 'Funeral Celebration at Cairo'; 'Serpent Charmer'; 'Alley of Sphinxes in the Thebaid'; 'Bazaar in Algiers'; 'Palm Sunday in Early Christian Times' (1853). He published 'Briefe aus Aegypten und Nebien.' He also made illustrations for Eber's 'Egypt' and others of his popular works.

GENUA, ancient name of Genoa (q.v.).

GENUFLECTION, jĕn-ū-flĕk'shŏn (Middle Latin *genuflexio,* bending of the knee) the act of bending the knee in reverence or adoration. In the Roman Catholic Church the members genuflect when passing before the tabernacle where the Blessed Sacrament is reserved. If the Sacrament is exposed a double genuflection (on both knees) is usual. Genuflection is used at various times during the church services. The early Christians prayed standing on Sundays, and from Easter till Pentecost, and only bent the knee in sign of penance; hence a class of penitents were known as *Genuflectents.* In the rubrics of the Anglican Church double genuflection, or kneeling, is enjoined in some parts of the service. Kneeling and bowing the head at the name of Jesus occasioned much controversy, especially among the Puritans. It seems probable that genuflexion crept into the church from its contact with the ceremonies of the royal court in Egypt, the prostrations of the Orient and like ceremonies among other neighboring civilized nations.

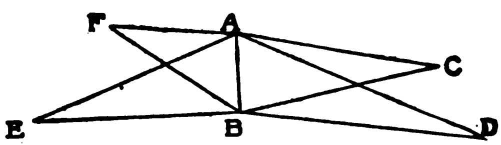
GENUNG, John Franklin, American clergyman and scholar: b. Wilseyville, N. Y., 27 Jan. 1850. He was graduated from Union College in 1870, from the Rochester Theological Seminary in 1875, and from the University of Leipzig, Germany, in 1881; was for a time active in the ministry of the Baptist Church, and later was appointed professor of rhetoric in Amherst College. After 24 years in that chair he was transferred to the department of literary and Biblical interpretation. He has degrees as follows: Ph.D., Leipzig; 1881; D.D., Yale University, 1905; L.H.D., Union University, 1913. His publications number 'Tennyson's In Memoriam: Its Purpose and Structure' (1883); 'Practical Elements of Rhetoric' (1886); 'Hand-book of Rhetorical Analysis' (1888); 'The Epic of the Inner Life,' a new translation with annotations of the Book of Job (1891); 'Outlines of Rhetoric' (1893); 'The Working Principles of Rhetoric' (1902); 'Stevenson's Attitude to Life' (1901); 'Words of Koheleth'; the Book of Ecclesiastes, with new translation and commentary (1904); 'The Hebrew Literature of Wisdom: a Synthesis' (1906); 'The Idylls and the Ages,' a valuation of Tennyson's Idylls of the King (1907); 'The Man with the Pitcher and his Story' (1912); 'A Guide Book to the Biblical Literature' (1916).

GENUS, jē'nŭs, in zoology and botany, a systematic term applied to any group of species (q.v.) lower in rank than a tribe, sub-family, or family. A genus may be composed of a single, several, or many species. Genera usually differ in structural details, while species differ in size or color, or in the structure of some special organ or portion of the body. It is, however, often difficult to draw the line between genera and species. As an example of a genus may be cited *Equus,* or the horse genus, represented by *Equus caballus,* the domestic horse; *Equus asinus,* the ass; *Equus zebra,* the zebra, etc. A genus may be represented by species inhabiting different continents, but sometimes a genus is confined to a single geographical realm or region. See paragraph on *Classification* in ANATOMY.

GEOCENTRIC, astronomical term employed to designate the position and motions of the planets from the position of a supposed observer stationed at the centre of the earth. See HELIOCENTRIC.

GEODE, a cavity of small size in a rock mass, which cavity has been lined or even filled with mineral matter that has been carried in by the circulating waters. Sometimes the lining is silica deposited in layers in the form of banded agate, sometimes it is quartz or calcite in beautiful crystals.

GEODESY. The science of measuring large portions of the earth's surface, continents, countries, etc., with a view to determining the form and dimension of our globe and of making maps of extended regions of its surface, differs from surveying (q.v.) in the wider regions which its scope includes, and in the corresponding necessity of more delicate and refined instruments and methods. As an example of the problem it involves: If a map of the United States is to be made, one of the many questions arising would be that of the exact distance on the earth's surface between two cities. This is obviously impossible of measurement in the familiar way with the tape line. To carry out such measurements the method of triangulation must be applied. To do this, two points must be found a few miles apart so situated that the distance between them can be directly measured on the ground, and that from each of them several different points in the region to be surveyed are visible. Let AB be



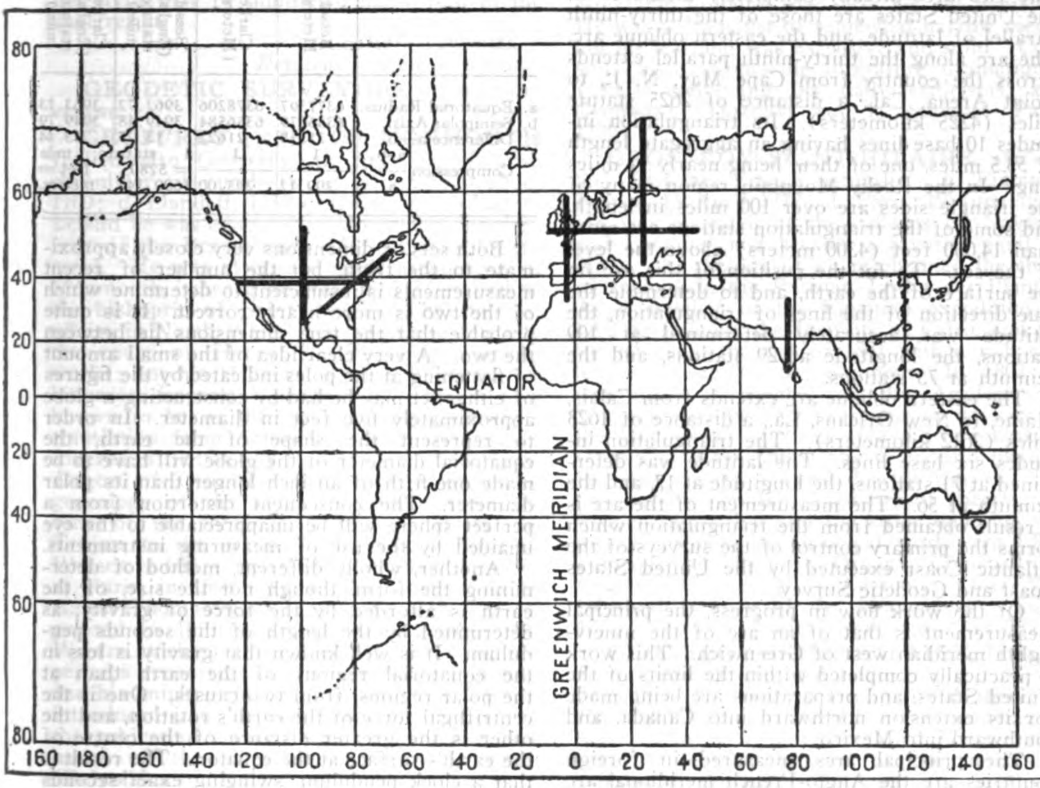
the two points chosen and C, D, E, F, etc., some of the distant points. The line AB is called the *base line* of the triangulation, and is measured by means of rods closed in wooden cases to protect them from rapid changes of temperature, which are successively placed end to end from the point A to the point B. Recently it has been found that steel tape can be used much more expediently and with all the precision that is required for the purpose. Having found the exact length of the base line, a theodolite is mounted at A and vertical rods or signals are erected at B C, so that the angle BAC can be measured with the greatest possible exactness. Then the theodolite is carried to the point B and the angle is measured in like manner. If practicable the theodolite may also be mounted at C in order to measure the remaining angle of the triangle. The sum of the angles should come out 180°, this being the sum of the angles of any plane triangle. These three measurements will show any error in the measurement of the angles. Knowing the three angles and of the side of the triangle, the computation of the two remaining sides is a very simple one in trigonometry.

Commonly there will be a number of points, C, D, E, F, etc., which can be determined at the same time. Having done this, any of the lines from A or B to C, or between any two of the other known points, may be used as a new base line and the distance of yet other visible points measured in the same way. These, again, can be used as new base lines, and so on indefinitely. This method is especially expeditious in mountainous regions, where observations can be made from peak to peak at distances sometimes exceeding 100 miles.

A fundamental point in which geodesy differs from surveying is in the combination of measurements of the earth's surface, with observations of the stars; the object of the combination is the determination of the curvature of the earth's surface and the size of our globe.

The principle involved will be readily seen by a little careful thought. It is obviously impossible to determine with any exactness the curvature of the earth's surface by observations made solely on that surface. But the surface of the ocean, which is taken as the basic one, is everywhere perpendicular to the plumb-line. It follows that the angle between the directions of the plumb-line at two points will be equal to the curvature of the ocean surface between the points. By skilful astronomical observations it is possible, on any part of the solid earth where an instrument can be mounted, to determine the exact declination in the celestial sphere from which the plumb-line points, which is, in fact, the zenith. The declination of the zenith is the latitude of the place; it follows, that if the latitude of two points north and south of each other is accurately determined, and found to be one degree, for example, the distance between them is the measure of one degree on the earth's surface. This distance can be determined between any two points which are connected by a geodetic measurement. The difference of longitude may also be determined astronomically by telegraph and by geodetic measurement of the earth's surface. The relation between the two measures shows the curvature in the east and west direction.

One of the most difficult questions connected with the figure of the earth is that of the exact ellipticity or flattening of our globe. The precise figure of the earth itself does not admit of definition on account of the irregular outlines of the mountains. Hence, as a basis of all exact statements, geodesy takes, as a standard body representing the earth, the figure that would be formed by the surface of the ocean if the continents were removed so that the ocean would cover the whole globe. It is clear that if the earth did not rotate on its axis, the form assumed by an ocean covering it would be that of a sphere. But, owing to the rotation, the equatorial regions of the earth are expanded and the polar regions contracted so that the ideal form is that of an ellipsoid. If all parts of the earth were of the same density this ellipsoid would be easily determined; but owing to the inequality of density of different parts of the earth, the figure of the ocean itself is not an exact ellipsoid. The best that can be done is to make the calculations assuming it to be such, and to make the best allowance that we can for such small deviations as may be discovered.



Measures for this purpose have been carried on or are in progress in most civilized countries. The exact form and size of the earth cannot be determined in the best way through observations in any one country, but require a combination of the geodetic surveys of various countries as widely separated as possible. With a view of securing co-operation in the solution of the problem, an International Geodetic Association was formed, comprising the United States and the leading countries of Europe. This association, represented by members from the various countries, meets from time to time to carry out the co-operative work of the association, and decide upon the best way of combining the several geodetic surveys.

The accompanying map shows the principal modern geodetic arcs which have been completely measured in different parts of the world, and affords a comparison of the work done by the United States with that of foreign countries. The two arcs already completely measured in the United States are those of the thirty-ninth parallel of latitude, and the eastern oblique arc. The arc along the thirty-ninth parallel extends across the country from Cape May, N. J., to Point Arena, Cal., a distance of 2625 statute miles (4225 kilometers). Its triangulation includes 10 base lines having an aggregate length of 53.5 miles, one of them being nearly 11 miles long. In the Rocky Mountain region many of the triangle sides are over 100 miles in length, and some of the triangulation stations are more than 14,000 feet (4300 meters) above the level of the sea. To fix the position of this arc on the surface of the earth, and to determine the true direction of the lines of triangulation, the latitude was accurately determined at 109 stations, the longitude at 29 stations, and the azimuth at 73 stations.

The eastern oblique arc extends from Calais, Maine, to New Orleans, La., a distance of 1623 miles (2612 kilometers). The triangulation includes six base lines. The latitude was determined at 71 stations, the longitude at 17, and the azimuth at 56. The measurement of the arc is a result obtained from the triangulation which forms the primary control of the surveys of the Atlantic Coast executed by the United States Coast and Geodetic Survey.

Of the work now in progress, the principal measurement is that of an arc of the ninety-eighth meridian west of Greenwich. This work is practically completed within the limits of the United States, and preparations are being made for its extension northward into Canada, and southward into Mexico.

The principal arcs measured in foreign countries are the Anglo-French meridional arc extending from the north of the British Isles southward through France and Spain into Africa; the great Russian meridional arc extending from the Arctic Ocean to the northern boundary of Turkey; the European latitudinal arc extending from the southern part of Ireland eastward into central Russia; and the great Indian meridional arc extending from the southern point of the Peninsula of India northward to the Himalayas.

The total length of all the arcs completely measured in all parts of the world during the modern period amounts to a little more than two-fifths of the girdle of the earth along a great circle.

The exact form of the earth as given by these measurements is such, that with considerable exactness all parallels of latitude are circles, and all meridional great circles are ellipses. The dimensions and form of the spheroid, or more properly, ellipsoid of revolution given by these co-ordinate circles and ellipses are usually stated in terms of its equatorial and polar radii, or diameters, and the two most notable computations of these dimensions are those made by Bessel in 1841, and those made by Clarke in 1866. The dimensions as determined by these computations and the compression values deduced therefrom, which are applied to all calculations in connection with modern geodetic work, and in the preparation of maps for exact surveys, are given in the following table, both the Bessel and Clarke computations being given in meters and English statute miles.

	Bessel Meters)	Clarke (Meters)	Bessel (English statute miles)	Clarke (English statute miles)
a. Equatorial Radius.	6377397	6378206	3962.72	3963.23
b. Semipolar Axis....	6356079	6356584	3949.48	3949.79
Difference a—b...	21318	21622	13.25	13.44
Compression $\frac{a-b}{a}$..	$\frac{1}{299.12}$	$\frac{1}{295.00}$	1 statute = 5280 1609.347.	mile feet = meters.

Both sets of dimensions very closely approximate to the truth, but the number of recent measurements is insufficient to determine which of the two is more nearly correct. It is quite probable that the true dimensions lie between the two. A very clear idea of the small amount of flattening at the poles indicated by the figures of either set may be had by constructing a globe approximately five feet in diameter. In order to represent the shape of the earth, the equatorial diameter of the globe will have to be made one-fifth of an inch longer than its polar diameter. The consequent distortion from a perfect sphere will be unappreciable to the eye unaided by the use of measuring instruments.

Another, wholly different, method of determining the form, though not the size, of the earth is afforded by the force of gravity, as determined by the length of the seconds pendulum. It is well known that gravity is less in the equatorial regions of the earth than at the polar regions, from two causes. One is the centrifugal force of the earth's rotation, and the other is the greater distance of the centre of the earth's surface at the equator. The result is that a clock pendulum, swinging exact seconds near the pole, would lose several seconds a day when taken to the equator; hence, a pendulum which would beat exact seconds must be made continually shorter as we approach the equator. The determination of its length in various latitudes thus becomes an important problem in geodesy. When it is known, the ellipticity or flattening of the earth may be determined from it.

What makes all the problems associated with this so complex are the small irregularities in the direction and force of gravitation wherever measures and determinations have been made. It is always found that when the latitudes of places are determined by the direction of the plumb-line, which is the only astronomical method, they seldom agree with the differences between the places as determined by geodetic measurements. The reason is, that the plumb-line is deflected by the attraction of mountains and denser portions of the interior of the earth which do not admit of exact computation. These irregularities are greater in mountainous regions, in the Himalayas sometimes rising to 30 seconds. But even in plain countries deviations of two or three seconds are found. The errors arising from these deviations would not be important in themselves, the difficulty being that they operate like a small error in a foot rule when the latter has to be used for measuring a very long stick of timber. In such a case an error even so small as one-eighth of an inch in the rule would amount to an error of a foot in measuring a pole 100 feet long. As the measurement of a whole continent, even of the earth itself, has to start from short base lines, the error may be multiplied many fold in the final result.

SIMON NEWCOMB.
Revised by ERIC DOOLITTLE.

GEODETIC SURVEYING. See SURVEYING.

GEOFFREY (jĕf'rĭ) **OF MONMOUTH** (called also GEOFFREY AP ARTHUR), English chronicler: b. probably at Monmouth about 1100; d. Llandaff, 1152 or 1154. According to Leland he was educated at Monmouth, in a convent of the Benedictines, whose society he entered. He was afterward made archdeacon of Monmouth, whence he was, in 1152, raised to the bishopric of Saint Asaph. The state of affairs in North Wales induced him to retire to the court of Henry II. He wrote various works; but his 'Historia Regum Britanniæ' is his most important production. This is now known to be, as the compiler states, chiefly a translation from Armorican manuscripts discovered in Brittany by Walter Calenius, an archdeacon of Oxford. It contains a pretended genealogy of the kings of Britain from the time of the fabulous Brutus, or Brute, the Trojan, to the death of Cadwallader, king of Wessex in 688. It was first printed by Ascenius at Paris, in 1508. An English translation by Aaron Thompson, at London in 1718, was reprinted in Bohn's Antiquarian Library, 1848. We are indebted to Geoffrey for preserving, and perhaps reconstructing, the legends of Arthur and his knights, the exquisite fiction of Sabrina introduced into Milton's 'Masque of Comus,' the subject of Shakespear's 'King Lear,' and many of the finest episodes in Drayton's 'Polyolbion.'

GEOFFRIN, zhō-frăn', **Marie Thérèse Rodet,** the holder of a noted Parisian literary salon: b. Paris, 2 June 1699; d. there, 6 Oct. 1777. By the grace and vivacity of her manners, aided by a refined and cultivated taste, she drew around her much of the fashion, wit, and learning of Europe. Early left a widow, with an opulent fortune, her charities to the poor, and her benevolent aids to literature, endeared her as much to society as her wit and virtue delighted. Three of her friends, Thomas, Morellet, and D'Alembert, dedicated particular writings to her memory. Consult Aldis, 'Mme. de Geoffrin and her Times' (New York 1905).

GEOFFROY, zhō'frwä', **Jean,** French artist: b. Marennes, Department of Charente-Inférieure, 1853. His art studies were made under the supervision of Levasseur and Eugène Adan. He first exhibited in 1874 and has become famed as a master in depicting childhood and poverty. In the Amiens Museum is his 'The Unfortunates'; while the Luxembourg Gallery has his 'Visiting Day at the Hospital,' and 'Prayer of the Meek.' These are his principal works. In 1900 he was awarded a gold medal at the Paris Exposition.

GEOFFROY, Julien Louis, French dramatic critic: b. Rennes, 1743; d. 1814. He was educated with a view of entering the Jesuit order, but when it was suppressed in 1774 he became a teacher. He was successively editor of *L'Année Littéraire*, the *Journal de Monsieur* and *L'Ami du Roi* and during the troubled years of the Revolution lived in retirement. In 1806 he joined the *Journal des Débats* as dramatic critic. He opposed the Encyclopedists and especially Voltaire, who was his pet aversion. He was a dramatist of somewhat narrow views, but his learning was extensive and solid. Consult Gosse 'Cours de littérature dramatique' (1820), containing his daily criticisms, and Geoffroy's 'Discours sur la critique' Paris 1779).

GEOFFROY SAINT-HILAIRE, săn'-tē-lär', **Etienne,** French naturalist: b. Etampes, France, 15 April 1772; d. Paris, 19 June 1844. He was educated at the colleges of Navarre and Lemoine, and became a favorite pupil of Haüy. At the age of 21 he obtained the chair of zoology in the Parisian Jardin des Plantes. As a member of the Egyptian expedition in 1798 he founded the Institute of Cairo, and returned about the end of 1801 with a rich collection of zoological specimens. In 1807 he was made a member of the Academy of Sciences, and in 1809 professor of zoology at the Faculty of Sciences. He devoted himself especially to the philosophy of natural history. He was closely associated with Cavour; but they differed on the mutability of species, the former supporting and the latter opposing the theory. Among his principal works are 'The Principle of Unity in Organic Composition' (1828); 'Philosophy of Anatomy' (1818–20); 'Natural History of the Mammifers' (1820–42); 'Ideas of Natural Philosophy' (1838).

GEOFFROY SAINT-HILAIRE, Isidore, French physiologist and naturalist, son of the preceding: b. Paris, 16 Dec. 1805; d. there, 10 Nov. 1861. He was elected to the Academy of Sciences in 1833, and afterward became successively inspector-general of the university, member of the council of instruction and professor of zoology at the Academy of Sciences. One of his chief works, 'History of Anomalies of Organization in Man and the Animals' (1832–37), adds valuable confirmation to the theories of his father. He was the means of founding the Acclimatization Society of Paris. He paid much attention to the domestication of foreign animals in France, as appears from his treatise 'Domestication et Naturalisation des Animaux utiles' (1854), and advocated the use of horse flesh as food in his 'Lettres sur les substances alimentaires' (1856). He also published an excellent life of his father (1848).

GEOGNOSY, jē-ŏg'nō-sĭ, that branch of Geology that treats of the materials that compose the earth. See CALCITE; LIMESTONE; MINERALOGY; QUARTZ; ROCKS, etc., also section on *Geognosy* in the article on GEOLOGY.

GEOGRAPHER OF THE UNITED STATES. The Continental army in the Revolution had a geographer to make maps and plans; and on 4 May 1781 Thomas Hutchins (q.v.), a protégé of Franklin's, was on his recommendation appointed geographer to the Southern (Greene's) army. After the peace, Hutchins's services were retained as geographer, in connection with the surveys of the Western lands ceded by the States. The first official note of the office is in the draft of the general land bill reported 26 April 1785, where it is referred to as existing, and shortly afterward Hutchins is referred to as occupying it. He was to supervise the State surveyors appointed by Congress, suspend them if unsatisfactory, and report to Congress. He was reappointed in 1788, for two years, but died the next year.

The first known official holder of the office of Geographer of the United States was Col. Robert Erskine. On the recommendation of Gen. James Clinton to Washington, Simeon De Witt the first graduate, in 1776, of Rutgers College (q.v.) was in 1778 appointed assistant to Erskine, whom he afterward succeeded, as per order of Congress, 4 Dec. 1780. He held this office until the end of the war. He then became Surveyor-General of the State of New York, holding that office for 50 years, though in 1796 offered the post of Surveyor-General of the United States, an honor which he declined. De Witt organized a corps of surveyors under Lieut. Benjamin Lodge, who with compass and chain measured every rod of Sullivan's great march from Easton to the Genesee valley, into the wilderness and lake region of New York. The maps then made, under the supervision of De Witt, became the basis of the subsequent cartology of Central New York, and these, with the maps made in 1778, by Captain Grey, auxiliary to the same expedition, are in the New York Historical Society library and are known as 'The Simeon De Witt Collection.' They were utilized especially by Gen. John S. Clark, in the years before 1889, in his remarkable identification of the places, with Indian names, referred to in the 42 journals of the officers in Sullivan's expedition.

GEOGRAPHIC NAMES, United States Board on, a board of 15 members, chosen from the executive department, the Government Printing Office, and the Smithsonian Institution, invested with power to render final decision, binding on all departments of the government, in settling the names of stations and places throughout the United States and Alaska, and to fix the spelling of the same in accordance with local usage. The board was instituted in 1890 by President Harrison. A separate board exists for the Philippine Islands. The reports of the board are issued from time to time by order of the Congress.

GEOGRAPHIC POSITIONS. See GEODESY.

GEOGRAPHIC SOCIETY, National, an American organization with headquarters at Washington, D. C. It was formed in 1888, and offers annual lecture courses in Washington upon popular geographical subjects. The *National Geographic Magazine* is published monthly by the Society, which had about 300,000 members in 1917 and a collection of rather more than 50,000 volumes in the library maintained in its building in Washington.

GEOGRAPHICAL BOTANY. See PLANT GEOGRAPHY.

GEOGRAPHICAL CONQUESTS. The 18th century, the third after the discovery of America drew to its close with darkness still shrouding half the globe from the eye of civilized man. A Strabo or a Ptolemy, if questioned in 1800 as to how much of the earth's surface he could describe with accuracy, would have had to confess that he was quite familiar with only one of the grand divisions, and that one embracing only a tithe of the land of our planet. He might perhaps have claimed that he could make a tolerable map of South America, whose interior had been partly opened up by the zeal of the Jesuit missionaries. It would, however, have been full of great voids representing regions unknown to him. He would have been able also to construct a map of Asia, approximately reproducing its main features, but his outlines would have been merely the framework of blurred and empty pictures. The Himalayas had not been measured — the Andes figuring as the highest mountains on the globe. There was a boundless area within the Chinese Empire untrodden by Europeans. In Asiatic Turkey, Persia and in Afghanistan, in Turkestan and the Pamir, there were whole regions removed from the ken of cartographers. Scant information existed regarding Japan, Farther India, and the Malay Archipelago; next to nothing was known about Korea, and the interior of Arabia was almost a blank. Australia was still floating as a cloud on the horizon. Most of the lands north of America had not yet been discovered, and the Antarctic realm had barely been touched.

The accurate knowledge of Africa was limited in the main to a narrow strip along the coast. As for the interior, comprising about one-fifth of the earth's land surface, geographical learning had hardly begun to outgrow its mediæval estate. Cartographers had been groping their way amid the confused reports of traders, slave dealers, and missionaries. The feature of Equatorial Africa regarding which the most correct conjecture had obtained for centuries, was the source of the Nile, which river, in accordance with the teachings of Ptolemy and the old Arab geographers, was represented on the maps as issuing from some lakes in the heart of the continent, fed by the Mountains of the Moon. Geographers knew of a great river that flowed by Timbuktu, the Queen of the Desert, and which they called the Niger, a name handed down from the time of the ancients. It had long been supposed that this stream had a western course and that the Senegal and Gambia formed its delta. A counter theory was that it flowed east to a large lake, a view based in part on vague reports about Lake Tchad. Still another theory regarded the Niger as one of the great arms of the Nile. The Kongo was known only in the last portion of its interminable course, though as far back as the 17th century the opinion had been entertained that it issued from the same quarter of the continent as the Nile. The Sahara remained untraveled by Europeans, except near its margin, and the great lakes of Africa were known only through tradition or vague report.

In North America, the region between the Mississippi and the Pacific and north of New Mexico still belonged in great part to the realm of fancy. British America remained in great part unexplored, and the coast of Alaska had barely been grazed. There were whole regions, like the Adirondack wilderness, included within the bounds of the original States of the American Union, which were still sealed to geographers.

Nearly 300 years after the tracing of the coast line of Africa was completed by the voyages of the Portuguese, the systematic exploration of the interior may be said to have commenced in 1788 with the foundation in London of the African Association, an event which inaugurated a new era in the history of geographical discovery. This society had the good fortune to command almost at the start the services of the intrepid Scotchman, Mungo Park. Before this, it is true, the pioneer of modern African exploration, Sir James Bruce, had made his memorable journey along the Blue Nile, and the ornithologist, Le Vallant, had traveled in the hunting grounds of South Africa. Just before we hear of Mungo Park, the record of discovery also tells of a narrow wedge driven toward the heart of the continent in the journey of Browne from Assuan to Darfur. The African Association assumed for one of its first tasks the unraveling of the mystery of the Niger. The journeys of Mungo Park (who perished in the stream in 1806), of Clapperton and Denham, and of Lander, covering together the period from 1795 to 1830, revealed the course of the river. The French, meanwhile, explored the Senegal and Gambia. At this time English explorers began to push from the Guinea coast into the warlike kingdoms of Ashanti and Dahomey. In 1826 the ill-fated Laing, and in 1828 Caillié, succeeded in reaching Timbuktu, that mysterious seat of Islamism which had for centuries fascinated geographers. (See FIGS. 1 and 2).

The close of the 18th century was the beginning of a new era in the annals of American exploration. The travels of Alexander von Humboldt between 1799 and 1804 in the basins of the Orinoco and Magdalena, and in the Andes and Mexican Cordilleras, mark an epoch in the history of geography and natural science. His work was taken up and extended to other regions, especially Brazil, by eminent naturalists like Maximilian of Wied, Spix, Martius, Auguste de Sainte-Hilaire, Orbigny and Pöppig. These had worthy successors in the brothers Schomburgk (British Guiana), Darwin (Patagonia, Tierra del Fuego), Avé-Lallemant (Brazil), Tschudi (Andes, Brazil), Castelnau (Brazil, Bolivia, Peru), and Burmeister (Brazil, Argentina).

By the acquisition of the Louisiana territory in 1803 the United States came into possession of a boundless domain, in great part as far removed from the knowledge of white men as the heart of Africa. (See FIGS. 5 and 6). An exploring expedition was immediately sent into this *terra incognita* under Lewis and Clark, who proceeded up the valley of the Missouri, crossed the divide of the Rocky Mountains and followed the Columbia down to the sea. The explorations of Pike, Long, Bonneville, Catlin, Nicolett, and Frémont, the opening of overland routes to Utah and California, and the government survey for a Pacific railway made deep rifts in the trans-Mississippi region; but its greatest wonders were to remain enshrouded till the tide of colonization had begun to sweep over the whole area. It was not till 1832 that the Mississippi river was traced to its source by Schoolcraft.

The exploration of the Arctic regions in the hope of finding a north water route for the trade with the East, had lost much of its fascination by the 18th century. Russia alone prosecuted it systematically in the course of that century, accomplishing a great work in tracing the coast line of Siberia. About the beginning of the 19th century the idea of a Northwest Passage was revived in England and the dream of reaching the pole began to be entertained. (See FIGS. 3 and 4). A great and persistent onslaught on the frozen North was inaugurated in 1818. The labyrinth of islands, peninsulas, and ice-bound passages north of the American continent yielded up its intricacies to the assaults of Parry, the two Rosses, Sir John Franklin (to whose tragic end Arctic discovery owed much of its rapid progress), McClure, Kane, McClintock and Hayes. The exploration of Arctic British America was prosecuted on land with heroic energy by Franklin, Back, Richardson, Beechey, Dease, Simpson, and Rae. Parry in an attempt to reach the pole in 1827 dragged his sledges over the floating ice fields to the parallel of 82° 45′, eclipsing all previous records by more than a degree of latitude. In 1831 James Clark Ross solved the mystery of the position of the north magnetic pole, which he located in the peninsula of Boothia. McClure entered the Arctic Ocean through Bering Strait in 1850, proceeded east, was beset for years in the ice, joined hands in 1854 with an expedition which had come in the opposite direction, and thus carried off the laurels of the Northwest Passage. While a great breach was being made in the Arctic fastnesses, Bellingshausen, Weddell, Dumont d'Urville, Sir J. C. Ross, Wilkes, and others extended geographical discovery into the Antarctic regions. Ross discovered Victoria Land, with its active volcanoes, and in 1842 advanced beyond the 78th parallel. During this same period the arid depths of Australia, whose coast had been explored by Flinders in 1801–03, were invaded by Sturt, Eyre and the ill-fated Leichhardt.

A flood of light was thrown on the geography of Northern and Central Asia in the first half of the 19th century by the journeys of Ermann, Humboldt, Middendorf, Huc (who entered Lhassa, the holy city of Tibet) and others; while men like Webb, Moorcroft and Wood scaled the heights of the Himalayas and the Pamir, and reached the head streams of the Indus, Ganges and Amu Daria. From 1848 Mount Everest, with the 29,002 feet given to it by the trigonometrical measurement of Sir Andrew Waugh, figured as the highest point on the globe. Among the naturalists who were attracted to the Himalayas, the name of the botanist Hooker stands pre-eminent. The most distinguished traveler in Southwestern Asia in the early part of the century was

Burckhardt, who succeeded in entering the holy places of Mecca and Medina. In 1829 Ararat was ascended by Parrot. In 1832–33 Alexander Burnes performed his famous ride from India to Bokhara. The travels of Crawfurd and MacLeod in the second quarter of the century dispelled in part the obscurity hanging over farther India. Between 1835 and 1849 the naturalist Junghuhn explored Java and parts of Sumatra. Among his successors in the Malay Archipelago were St. John and Wallace.

Down to the time of the French Revolution, Europe had hardly dared to cast a covetous eye on the interior of Africa. Portugal, England and France held sway at a few stations along the coast. The sturdy Boers, near the Cape of Good Hope, alone represented actual colonization by Europeans. The Revolution brought in its train Bonaparte's conquest of Egypt, the first great onslaught on African territory on the part of Christendom in modern times. The consequences of the French domination, brief as it was, were far-reaching in the loosening of Turkey's hold upon that country. Another result of the wars of the revolution was the supplanting of Dutch dominion at the Cape by that of England. An army of ardent missionaries now made their way into the interior of South Africa. While England was laying the foundations of an empire at this end of Africa, France suddenly invaded the north and conquered Algeria (1830–48). A few years before this invasion, Mehemet Ali, viceroy of Egypt, brought Nubia and Kordofan under his sway. This ambitious potentate, who, for the first time since the days of Saladin, made the aggressive power of Africa felt in another continent, in his rôle of modernizer of Egypt, sent various scientific expeditions to explore the Nile, which was now traced almost to the equator. To this period of African exploration belong the travels of Rüppell, the brothers Abbadie, Beke and Krapf in Abyssinia.

With the middle of the 19th century commenced an extraordinary era in the history of geographical discovery. The world began to close in upon the dark interior of Africa, and in the course of a generation the great features of the continent were unfolded almost in their entirety. In 1847 the German missionaries Krapf and Rebmann discovered the snow-capped peaks of Kilima-Njaro and Kenia, near the equator. In 1849 Livingstone discovered Lake Ngami, in the heart of South Africa, at a distance of 1,000 miles from Cape Town. In the course of the next seven years he extended his explorations to the Upper Zambesi, of which mighty stream hardly anything had hitherto been known, followed it up, struck out west along the edge of the Kongo basin (a circumstance unknown to him), made his way to the Portuguese possessions on the Atlantic, then, turning back, followed the Zambesi down stream, discovered the Victoria Falls, the rival of Niagara, and came to the shores of the Indian Ocean. While Livingstone was drawing a luminous trail across South Africa from sea to sea, Heinrich Barth was lifting the veil from the depths of the continent on the other side of the equator by his extraordinary journeys in the west half of the Sudan. In the sixth and seventh decades of the century large accessions were made to the knowledge of the Nile basin and the surrounding regions, including Abyssinia, by the travels of Petherick (who explored the basin of the Bahr-el-Gazal), Munzinger, Beurmann, Heuglin, and others. In the meanwhile the French were pushing into West Africa on the side of Senegambia, Du Chaillu traveled in the country back of the Gabun and through the wilds of the Ogowe, the home of the gorilla and the pygmy Obongo; Burton scaled the peak of Kamerun, and Von der Decken explored what is now British East Africa.

Just as Barth was emerging from the scorching suns of Central Africa, laden with the knowledge of countless peoples, in another continent three equally intrepid Germans proceeded to explore the most elevated region of the globe. The brothers Schlagintweit crossed the Himalayas and the Karakoram, traversed the lofty plateau of Tibet and surmounted the Kuenlun, reaching heights to which no traveler had ever climbed.

Soon after Livingstone's traverse of South Africa, the beginning was made of those discoveries which unraveled the most interesting problem presented by the geography of that continent. In 1858 Burton and Speke, dispatched by the Royal Geographical Society in quest of a great reservoir of fresh water which was believed to exist somewhere in the region whence the Nile issued, discovered Lake Tanganyika. Before the close of that year, Speke discovered a still larger lake, the Ukerewe, or Victoria Nyanza, which he assumed to be a reservoir of the Nile, though as yet its outlet remained to be found. To what river system, if any, Lake Tanganyika belonged was a problem which was to wait still many years for a final solution. In 1859 Livingstone came to the shores of a third great lake, the Nyassa, a feeder of the Zambesi. Within the next five years the question of the sources of the Nile was approximately settled by the explorations of Speke, Grant and Baker. The last named, ascending the river from Egypt in 1864, discovered the lowest of the Nile reservoirs, the Mwutan Nzige, or Albert Nyanza. What Ptolemy had laid down on his famous map 1,700 years before was found to be substantially correct, and the discovery later on of snow-clad mountains near the Albert Nyanza, culminating in Ruwenzori, substantiated what the Greek had taught regarding the Mountains of the Moon.

The problem of the Nile was closely interwoven with that of the Kongo, the greatest mystery that still confronted geographers outside of those presented by the polar regions. The Nile question, indeed, could not be regarded as completely settled till the watershed between the two rivers had been determined. Of the Kongo basin, equal in extent to that of the Mississippi, but a mere fraction was known to the world. A boundless maze of tropical forests and rivers had thus far escaped the eye of Europeans. Geographers were not even agreed as to whether the Kongo issued from the heart of the continent or whether it was not rather in the nature of a coast river. Livingstone applied himself with heroic resolution to the task of ascertaining the parting of the waters that found their way to the Mediterranean and those that flowed toward the Atlantic. In 1867-68 he discovered the Luapula, the east headstream of the Kongo, and its two large reservoirs, Mweru and Bangweolo, and in 1871 stood on the banks of the great river that hurries past Nyangwe, but not possessed of the information that would assure him beyond doubt that it could be no other than the Kongo.

During these years wide explorations were made in Central Africa, north of the equator, by Rohlfs, Nachtigal and Schweinfurth. Nachtigal, a worthy successor of Heinrich Barth, succeeded in making his way into Wadai, a Mohammedan state in Sudan, a goal the pursuit of which had cost the lives of two eminent explorers, Vogel (1856) and Beurmann (1863). Schweinfurth penetrated into the cannibal regions west of the equatorial Nile, and in 1871 came to the Welle, whose west course convinced him that he had traveled beyond the bounds of the Nile.

These journeys were coincident with a remarkable epoch in the geographical annals of America. The explorations of Dall revealed the extent of the Yukon; the mountain systems of the West were explored by Wheeler, Whitney and Hayden; Powell traversed the grand cañon of the Colorado; Washburne and Hayden made known the marvels of the Yellowstone. The knowledge of British America was at this time greatly extended by the travels of Bell, Selwyn, Dawson and others. Simultaneously with the exploration of the mountains of North America, the geological structure of the Andes was laid bare by Reiss and Stübel, who ascended the volcano of Cotopaxi to its summit.

While the rest of the world was engaged in prying open the recesses of the continents, the Russians were displaying extraordinary activity in the exploration of their vast Asiatic domain and the regions bordering on it. In the first 15 years of the reign of Alexander II, Semyenov, Valikhanov, Radlov, Ostensacken, Syevertsov, Fedtchenko and Kaulbars assailed that mighty mountain barrier composed of the Altai, Alatau, Tian-Shan, Alai Tagh and the Pamir, which shuts off the elevated desert region of Central Asia from the plains of Western Turkestan and Siberia. During the same period Shishmarev, Mattussovski and Pavlinov penetrated into Mongolia, and Palladius into Manchuria. The Russian advance into Central Asiatic highlands met with a prompt response from beyond the Himalayas, whence Hayward, Shaw and Forsyth pushed into Eastern Turkestan, while the pundit Nain Singh made a memorable traverse of Tibet.

When Japan and China, soon after the middle of the 19th century, opened their portals to the world, the work of exploration, previously inaugurated by dauntless missionaries and naturalists, proceeded with a new impetus. Great journeys were made in China by Blakiston, Pumpelly, Ney, Elias, Bastian, Cooper and Richthofen, who belong to the foremost ranks of Asiatic explorers. In the decade beginning with 1861 explorations were made in the Caucasus, by Radde, in northern Arabia by Palgrave, and in Turkestan by Vámbéry and Lagrée and Garnier traced the course of the Mekong as far up as the Chinese province of Yunnan. Contemporaneous with these travels were the remarkable journeys performed in Australia by Burke and Willis, MacKinlay, Stuart and Forrest, whose exploits were emulated by Giles and Warburton.

The year 1871 is memorable in the history of geographical discovery for the dramatic episode of the finding of Livingstone by Stanley. The meeting by the waters of Tanganyika was followed by the exploration of the north end of the lake which was found to have no outlet in that direction. Livingstone then returned to the scene of his recent labors, the Luapula-Lualaba basin. On 1 May 1873, he expired on the shores of Lake Bangweolo, which he had discovered and which he had become convinced belonged to the Kongo system. In 1874 Cameron discovered that Lake Tanganyika was connected by an outlet, the sluggish Lukuga, with the river formed by the Lualaba and Luapula. This river (which Livingstone had reached in 1871 at Nyangwe) was found by Cameron to flow at too low a level to admit of its belonging to the Nile system. This fearless traveler was prevented by the hostility of the natives from descending the stream and verifying his belief that it was the Kongo. It was reserved for the dauntless spirit of Stanley to bring the mightiest of African rivers within the ken of mankind. In November 1876 he embarked at Nyangwe in a fleet of canoes, and performing an unprecedented voyage which twice carried him across the equator, he reached the tides of the Atlantic in August 1877. And now came the great task of exploring the Kongo tributaries, which enlisted the energies of Stanley, Capello and Ivens, Buchner, Pogge, Wissman, Grenfell, Wolf, Brückner and Van Gèle.

While the veil was being lifted in this quarter, new light was thrown on the regions west of the Upper Nile by the travels of Junker, Casati, Gessi and Lupton, the country between the Ukerewe and the coast was opened up by Fischer, Thomson, and Johnston, the naturalist Emil Holub traveled in the Zambesi region, and the explorations of Brazza between the Ogowe and the Kongo laid the foundations of a new French colony. Between 1878 and 1881 Serpa Pinto made his traverse of South Africa, Oskar Lenz performed a journey from Tangier to Timbuktu and thence to the Senegal, and Matteuci crossed from Egypt to the Gulf of Guinea. At this time began the extraordinary career of Emin Bey (Eduard Schnitzer), administrator, explorer, naturalist and linguist, in the region of the equatorial Nile. This heroic commander, the peer of the great Gordon, was cut off for years from the world by the Mahdist uprising, till at last Stanley succeeded in reaching him by way of the Kongo and Aruwimi, an exploit which recalled the days of the Conquistadores. In 1887 the Rudolf lake was discovered by Teleki. In 1889 Meyer reached the summit of Kilima-Njaro.

During the years which revealed the sources of Africa's greatest rivers the exploration of the mighty tributaries of the Amazon was prosecuted by Chandless. A little later Crevaux won laurels in the same field and to him succeeded Karl von dem Steinen and Ehrenreich.

The decade which witnessed the solution of the Kongo problem, the last great mystery that had remained hanging over the equatorial zone, was marked by renewed activity in Arctic research. The passage leading north from Baffin Bay, beginning with Smith Sound, appeared to promise access to an open polar sea, the theory of whose existence had been put forth by Kane. The American expedition under Captain Hall in 1871 proceeded up this channel and the splendidly equipped British expedition under Sir George Nares in 1875 followed in its wake; but Kane's theory was not verified. Some of Nares' men in 1876 reached the parallel of 83° 20', eclipsing Parry's record by more than half a degree. Lieutenant Lockwood of the ill-starred Greely scientific mission in 1883 made a farther gain of four minutes. In 1873 the Austrian expedition of Weyprecht and Payer discovered Franz-Josef Land. In 1878–79 Nordenskjöld immortalized himself by accomplishing the Northeast Passage.

While Stanley and his successors were opening up the exuberant forest realm of Equatorial Africa, the arid expanse of Central Asia, stretching from the Pamir on the west to the highlands of Manchuria on the east and embracing the desert of Gobi (Shamo), the Tarim basin, with the Takla Makan desert, and the ranges of the Tian-Shan, Kuenlum, Altyn Tagh, and Nan-Shan, was attracting the most intrepid explorers from all parts of the world. This illustrious roll includes the great Przhevalski (whose name is borne by the former town of Karakol, in Turkestan, where he died in 1888); Sosnovski, Mushketov, Kostyenko, Potanin, Regel, the pundit Krishna (who removed the long-existing doubt regarding the identity of the Sanpo and Brahmaputra), Pyevtsov, Bell, Bogdanovitch, Roborovski, Carey, the brothers Grum-Grzhimailo, Rockhill, Younghusband, Bonvalot, and Henry of Orleans. These had distinguished successors in the last decade of the century in Dutreuil de Rhins, Littledale, the Swedish geologist Sven Hedin, Obrutchev, Futterer, Holderer, and Deasy. Among the host of ardent explorers who have traveled in China since 1875 are Sosnovski, Baber, Gill, Széchényi (son of the great Hungarian patriot, Count Stephen Széchényi), Kreitner, Easton, Hosie, Colquhoun, Henry, and Younghusband. It is only since 1880 that the geography of Korea has emerged from its obscurity.

In the last quarter of the 19th century the dimensions of the unknown in Alaska, the Northwest Territories, and Labrador were vastly reduced by the explorations of Muir, Allen, Schwatka, Dawson, Ogilvie, Russell, Low, and others. In 1888 the first crossing of Greenland's great ice cap (in its southern part) was accomplished by Nansen. In 1892 Peary and Astrup made a sledge journey of more than 1,000 miles over the northern end and determined the extension of the island in that direction. In 1893–95 the gap between the North Pole and the highest latitude ever before reached (Lockwood's 83° 24' in 1883) was bridged almost half over by Nansen's drift voyage and sledge journey, which carried him to the parallel of 86° 14'. This record was eclipsed in 1900 by the expedition of the Duke of Abruzzi, which reached 86° 33'. The results of these expeditions rendered it improbable that any extensive land mass remained undiscovered within the Arctic Circle; physical conditions verified 6 April 1909, when Com. R. E. Peary reached the North Pole by a sledge journey from Cape Columbia, Grant Land. His soundings at the Pole reached no bottom, the depth exceeding 9,000 feet.

In the same year in which Peary and Astrup crossed the fathomless ice cap of Greenland the gigantic glaciers of the Karakoram were explored by Sir William Martin Conway, who climbed to an elevation of about 23,000 feet, eclipsing the record of all former travelers. In 1897 Aconcagua, probably the loftiest peak of the Andes, was scaled to its summit by Zurbriggen, the Swiss guide, and Vines, the geologist of Fitzgerald's expedition, the elevation obtained for it by barometric measurement being 23,080 feet. In 1898 Conway accomplished the ascent of Illimani, one of the rivals of Aconcagua.

At the close of the 19th century the attention of the world was once more turned, after a long intervals, to the Antarctic regions. The British expedition under Borchgrevink (1898–1900) succeeded in locating the south magnetic pole and attained to the parallel of 78° 50', surpassing by 40' the "farthest south" achieved by Ross in 1842. In the expedition of 1907–09 Sir Ernest Henry Shackleton reached lat. 88° 23' S., long. 162 E., within 97 miles of the Pole. On 16 Dec. 1911 Capt. Roald Amundsen reached the South Pole and returned safely. His tent and records were found a month later, 18 Jan. 1912, by the ill-fated Capt. F. R. Scott, who with three companions died from privation while returning, 29 March 1912. When the 19th century opened, geographical science had half a world to conquer. At its close this conquest may be said to have been well-nigh achieved.

GEOGRAPHICAL DISTRIBUTION OF GOLD MINING. See GOLD MINING.

GEOGRAPHICAL SOCIETIES are associations formed with the view of obtaining and disseminating geographical knowledge. This is attained, in the first instance, by members undertaking distant travels, at their own expense in some cases, in others assisted by the funds of the society or grants from government; and, in the second instance, by lectures delivered and works issued under the auspices of the society, or by papers read and commented on at the periodical meetings. In point of seniority the first of these associations is the Société de Géographie of Paris, founded in 1821. The German Gesellschaft für Erdkunde held its first sittings in Berlin in 1828, under the presidency of Ritter, and has counted among its members many of the most famous of modern geographers. By far the most important of these institutions in Europe, however, is the Royal Geographical Society, established in London in 1830. The principal travelers and geographers of Great Britain, or indeed of the world, are or have been connected with this society, and such names as those of Livingstone, Burton, Baker, Speke, Barth, Wallace, Cameron, Stanley, Thomson, Johnston, Bent, Curzon, Markham, Nansen and many other well-known travelers, are to be found attached to papers in its *Journals* (1831–80, 50 vols.) and *Proceedings* (ceased in 1892), or in the *Geographical Journal,* which it has issued since 1893 in monthly parts, and which includes the society's proceedings. It also issues a 'Year Book,' pamphlets, etc., and large sums are devoted annually to aid the cause of geographical research, or as awards and recognition of services rendered to the science. The Russian Geographical Society, founded at Saint Petersburg in 1845, has greatly extended our knowledge of Central Asia and Asiatic Russia. Following the lead of other nations, Italy has her Società Geografica, founded at Florence in 1867, and issuing an annual *Bollettino*. The American Geographical Society (q.v.) was founded at New York in 1852 and the National Geographic Society (q.v.) at Washington, D. C., in 1888. The Royal Scottish Geographical Society was founded in 1884. It publishes an excellent monthly magazine, and its members number between 1,500 and 1,600. The Royal Geographical Society had a membership of about 5,000 in 1916, and about 50,000 volumes (besides an invaluable collection of maps and charts) in its library.

GEOGRAPHICAL SOCIETY, American, a society established at New York in 1852 to encourage geographical exploration and discovery, to disseminate new geographical information, and to maintain a place where the means shall be afforded of obtaining accurate information for public use concerning every part of the globe. In 1916 the members of the society began to extend its field of usefulness in several directions. It gave financial support to the Crocker Land Expedition in that year. It also gave public exhibitions of war maps and also did good work in illustrating various phases of economic geography. The old *Bulletin* of the society has become the *Geographical Review,* a periodical larger in scope than its prototype. A special volume is issued annually by the society. The first volume, that of 1916, was Isaiah Bowman's 'The Andes of Southern Peru.' In 1917 the society published Leon Dominion's 'The Frontiers of Language and Nationality in Europe.' In 1918 the society issued a volume on the relation of topography to military strategy on the battle fronts of Europe. Fellows of the society are entitled to free copies of these publications. The society has at present over 3,600 fellows.

GEOGRAPHICAL SOCIETY, Royal, was founded at London in 1830 to aid in scientific research in geography, and received a charter in 1859, under which its objects have been the advancement and diffusion of geographical science and the encouragement of exploration. Its pursuit of those objects has been characterized by ability, energy and wise generosity. See GEOGRAPHICAL SOCIETIES.

GEOGRAPHICAL SOCIETY OF BALTIMORE, organized in 1902 for the study of geographical science. It acquired over 1,000 members during the first year of its existence. Daniel C. Gilman was its first president.

GEOGRAPHICAL SOCIETY OF PHILADELPHIA, an organization devoted to the advancement and diffusion of geographical knowledge. It confers annually, as a reward for eminent service to the science of geography, the Elisha Kane gold medal; it supplies funds for use in exploration; it publishes a bulletin and maintains a library. The society dates its inception from 1891. As the "Geographical Club of Philadelphia" it received a charter in 1893 — the first president being Angelo Heilprin; and four years later adopted the present title. The membership numbered about 1,000 in 1917.

GEOGRAPHY, by derivation, means "description of the earth." Humboldt's interpretation, which, beyond the gathering of data for mapping the topographical and drainage features of a region, added a study of meteorological and climatic conditions, of the character of soils, and of the distribution of life both animal and vegetable, was the first true impulse given to modern geographical research. For a comprehensive knowledge of the earth the aid of all branches of natural science is sought. Geography, while it is specifically the science or knowledge of the earth, is dealing with phenomena and studying laws which belong to the universe. One of its important functions is the investigation of the reciprocal relations existing between man and his physical surroundings. The average text-books have fallen far below such a standard. Cartography and statistics form the sum and substance of these treatises. Maps constitute an essential feature of geography, but are commonly read with less intelligence than the working drawings of an engineer or architect. Lists of cities with their populations, and the names of rivers, bays, mountains and islands are of great value in the way of information, but they are of secondary importance. It concerns the student of geography less to know that New York is the largest city in the world and the greatest seaport of America than to discover the causes which have led to such growth and development. The physical or social reasons for the fixing of political boundaries are of greater interest than the mere location of or changes in the boundaries themselves. Happily a change for the better may be observed. The recognition some years ago of the scientific and practical value of geography by German scholars and the systematic work done by them have already borne fruit. Departments of geography have been established in universities and higher institutions of learning. Geographical societies have been organized in all the leading countries of the world, and a broader interest in the subject has been aroused.

Historical.— When Columbus (q.v.) made his first voyage of discovery, popular belief maintained that the earth was flat, though the scholars of the time recognized its spherical form. The first people to add to a knowledge of distant lands were the Phœnicians. They had founded colonies as early as 1200 B.C., and exerted much influence upon the progress of civilization. Herodotus, the father of history and geography, and himself a great traveler, records a Phœnician expedition in the 7th century B.C., which, starting from the Red Sea, returned by way of the Pillars of Hercules and the Mediterranean, having circumnavigated Africa. While the story has been doubted, the incidents of the narrative give it much color of probability. Herodotus leaves an account of the conception of the earth's extent in the 4th century B.C. The scanty knowledge of the time comprised the coast regions of the Mediterranean Sea extending vaguely to the north and south, with the Atlantic Ocean and the Persian empire constituting the western and eastern boundaries. Strabo's voluminous work on geography, at the dawn of the Christian era, itself a valuable treatise, is of special importance in affording a glimpse of the efforts of earlier geographers, whose books are lost. Eratosthenes, the most remarkable of these scholars, made wonderful advances in mathematics and astronomy. He measured the obliquity of the ecliptic, described the earth as a sphere revolving on its own axis, and constructed maps with parallels of latitude and longitude. Beyond influencing the belief of a few learned contemporaries, his work was practically unavailing. Ptolemy, who lived in the 2d century A.D., was the supreme authority in astronomy and geography, not only in his own time, but during the Middle Ages. In accordance with his system, which was really a compilation of the views of earlier writers, the centre of the universe was the earth, around which the various heavenly bodies revolved. The travels of Marco Polo in the 14th century and the introduction of the mariners' compass were instrumental in changing the whole history of the human race.

Though the knowledge of our world progressed by leaps and bounds, it is interesting to note what a large proportion of that knowledge has been the result of modern investigation. Explorers on the sea had by the end of the 18th century become familiar with the range of the ocean, the outline of the continents and many islands, but at the beginning of the 19th century four-fifths of the land area were unknown. Africa, with the exception of a narrow rim of coast, was indeed a «Dark Continent.» Little had been added to our knowledge of Asia since the days of Marco Polo. West of the Mississippi, North America was a *terra incognita,* and the existence of the Rocky Mountains was not suspected. Even the coast of Australia was not completely traced, and nothing had been learned of its interior. South America, which was better known than any continent except Europe, is now the least explored of all the large land masses.

While the unity of geography should never be overlooked, the subject is commonly divided into different branches, the chief of which are mathematical, physical and political geography.

Mathematical Geography considers the earth as a globe, with its motions and their effects, and teaches the methods of representing the whole or portions of the earth's surface on globes or maps. Observation and careful measurements have proved the earth to be spheroidal in shape. As it is flattened at the poles, it is not a perfect sphere, nor even a perfect ellipsoid, but a ball with slight irregularities of surface. Its longest diameter is 7,926.6 miles, and its shortest 7,899.6 miles. The circumference is approximately 24,000 miles.

The axis of rotation of the earth is its shortest diameter. The ends of the axis point to opposite parts of the sky, and these, called the poles of the heavens, seem to stand still while the rotation of the earth causes an apparent revolution of the sky from east to west. The whole system of determining position and direction is established by the earth's rotation. The great circle midway between the poles is the equator. Great circles extending north and south through the poles are meridian circles. Distance from the equator toward either pole is called latitude, and is measured along a meridian. Zero is at the equator, and the quarter circle north or south is divided into 90 degrees (expressed as 90°). Small circles parallel with the equator are parallels of latitude. The equator and parallels are continually moving from west to east, and the meridians, which cross them at right angles, are carried in succession directly beneath the sun. All points on any meridian turn around the axis at the same rate, but the actual distance traversed varies from nothing at the poles to more than 1,000 miles per hour at the equator. The uniform rotation of the earth provides a means of measuring time. The sun crosses the meridian or midday line of any place midway between the hours of rising and setting, and the interval between two successive noons is called a day, which is divided into 24 equal parts or hours. It is always noon on some meridian, but never on more than one at the same instant. As a complete rotation through 360° occupies 24 hours, meridians 15° apart vary one hour in local time. A person traveling toward the east completely around the world gains a day, but if he makes the same journey in a westerly direction he loses a day. Distance east or west is measured on the equator or a parallel, and is called longitude. Some prime meridian, usually that of Greenwich, is the zero, and measurements are made 180° east and west. The length of a degree of latitude is a little more than 69 miles, but as the meridians converge toward the poles, degrees of longitude diminish in length as the distance from the equator increases. If the latitude and longitude are unknown, the former is determined by observing the altitude of the pole of the heavens, while the latter is obtained by comparing, with the aid of a chronometer, the exact moment at which the sun crosses the meridian with the local time of the prime meridian at the same instant. Tables, showing the relative positions of heavenly bodies for each day in the year, are calculated in advance and enable captains of vessels to find their position at sea.

The imaginary network of meridians and parallels can be actually drawn upon a globe. The outline of the continents and the location of places may thus be depicted with great accuracy. A map is much more convenient than a globe, but, as the surface of a sphere cannot be spread out flat, no map is ever absolutely correct. Various projections are employed to modify the distortion. Mercator's projection, and others similar in plan, are modifications of the result obtained by drawing lines from the centre of a sphere through the parallels and meridians to the surface of a cylinder touching the sphere at the equator. This style of projection is employed for navigators' charts, for while areas are distorted, a straight line drawn between any two points correctly represents direction. Several hemispherical projections upon a flat background are used. These, though approximately preserving dimensions, distort directions. For limited areas the conical projection is of value. The meridians and parallels appear as they would if traced on a transparent cone placed on the globe.

Physical Geography deals with the earth in its relation to nature. The surface is irregular, the hollows being filled with water and the projecting parts forming the dry land. It is surrounded by a gaseous envelope. The solid portion is often called the geosphere or lithosphere; the liquid layer, the hydrosphere; and the outer mantle, the atmosphere. See AIR; ATMOSPHERE; VAPOR.

The earth is believed to be a cooling and contracting body. With a reduction in size the outer crust becomes wrinkled. The crests of these wrinkles protrude above the water, which fills the troughs. Without altering the relative positions of the exposed land masses and the oceanic basins, a comparatively slight increase in the depth of the latter would cause more land to be uncovered. Or were the bed of the ocean to be raised slightly, the sea would flow over the coast regions and accessible low-lying valleys. Were the solid crust uniformly smooth, it would be completely drowned by a continuous sea about two miles in depth.

By the present arrangement, the land area constitutes 28 per cent of the surface. The ocean covers about 72 per cent, but by evaporation and condensation, some of the water is distributed over the continents to be retained in lakes or returned to the sea by rivers. Though special names are given to different portions of the ocean, it is a continuous body of water.

The surface temperature of the ocean varies with the latitude. Ice floes and icebergs form in the polar seas, while an average temperature of 80° is maintained in the tropical ocean. The daily or seasonal range is not great in any latitude. Even in the tropics heat does not extend far below the surface and the ocean as a whole is a mass of cold water.

The amount of dissolved salts in sea water averages 3.5 per cent. The salinity is not uniform, as portions are regularly freshened. These are chiefly the belts of equatorial rains, the regions affected by the melting ice of the polar seas and those near coasts receiving the drainage of large land areas. As heat expands sea water, thus reducing its density, it generally happens that the surface water is saltier than the colder layers below. The distribution of heat and the modification of climate effected by ocean currents is of vast importance. Nearly half the sun's heat in the Torrid Zone is carried to higher latitudes. The Arctic regions receive more heat from the Gulf Stream than they do directly from the sun. The western coast of Europe from the North Cape to Gibraltar has a climate much warmer than that of the opposite coast of North America and this work of the Gulf Stream is in a measure duplicated on the western coast of North America by the Japan current. Cold currents from the southern ocean soften the climate of the western tropical coasts of Africa and South America. If the water completely covered the earth, a double wave caused by the attraction of the moon would, on account of the earth's rotation, travel around the globe every day. This ideal arrangement of tides is not realized except in the southern ocean, and, with a general movement to the west, the tidal wave is deflected northward in the other oceans.

In determining the height of mountains or any part of the land surface, it is necessary to have some common level as a basis of comparison. For this purpose the surface of the sea has been chosen, but on account of the many movements to which the ocean is subjected and because of the attraction exerted by elevated land masses, its surface is not level, and all comparative heights are of doubtful value. Efforts have been made to determine the mean level of the whole land surface. While much has yet to be accomplished in securing the requisite data, it has been quite clearly shown that such a line lies about 10,000 feet below present sea-level. The abysmal area below this line is of equal extent with the area above it. As the exposed continental area occupies 28 per cent of the earth's surface, it follows that 22 per cent is covered by water less than 10,000 feet in depth. Quite a large part of this region slopes gently away from the coast line to a depth of 100 fathoms, forming the continental shelf. The area of this submerged shelf is very nearly the same as that of the low costal plains of which it is a continuation. Were the level of the sea to be reduced 600 feet, 10,000,000 square miles would be added to the land area, and the present exposed surface would sustain a loss somewhat greater were the sea to rise an equal amount. The proportion of land is much greater in the northern than in the southern hemisphere and the large land masses have their greatest width in the north.

The destructive agencies are so active that in a short time all the land would disappear and be distributed over the bed of the ocean were it not for the upheavals due to the contraction of the crust. From causes, concerning which all geologists do not agree, lines of weakness are developed and portions of the crust are forced up into mountain ranges or broad plateaus, while other adjacent portions are depressed. The outer rocks or those forming the slopes of a young mountain range are composed of the sediment of older rocks. They are the result of processes of destruction and reconstruction, which are to be at once renewed. For no sooner are new areas exposed than the sun either by direct heat, or through the agency of wind, frost, rain, or running water, proceeds to carve the surface into new forms, carrying away the waste to cover the rocks with soil for the support of vegetation or to fill up the hollows of the sea. Rain not only attacks the rocks by force of impact and solution, but by moving broken fragments from higher to lower levels it uses them as cutting tools. The surface water and that flowing from springs form little streams, which uniting produce rivers. In its upper course, which is the steepest, the work of a stream is purely destructive. It is cutting a gorge or valley in the high land. As the slope becomes more gradual, it is alternately depositing its load of stones and gravel or sweeping them away to some lower point. In its final stretch through a nearly level area it is building up an alluvial plain. Deltas and many interior valleys, like that of the Mississippi, are thus formed. Rivers carry away immense quantities of solid material and are continually cutting down or extending their basins. The tendency of river work is to reduce the land to a dead level and a subdued surface is usually an indication of old age.

Relief, or the vertical aspect of a land area, is the result of the forces of upheaval and erosion, which are continually at work. The arrangement of mountains, plateaus and valleys varies in the different continents and upon the arrangement, climate, the possibilities of development, and the history of a county largely depend. The principal mountain ranges are however, so disposed that the largest drainage areas are tributary to the Atlantic Ocean or its arms. Asia, the largest continent, has the greatest average elevation and the highest point of land.

The many changes in the inorganic world profoundly affect the organic world and the distribution of life. In turn the very processes of nature are largely influenced by living organisms. The spread of any species, animal or vegetable, is promoted or retarded by such geographical features as oceans, mountains, plains, deserts and climate, but marine animals, by withdrawing dissolved carbonate of lime from the sea water, have constructed mountains of limestone, and vegetation retards the work of denudation, regulates rainfall and modifies the rate of evaporation. Plants alone are able to construct organic from inorganic material and animal life is dependent directly or indirectly upon plants for food.

All plants and animals are adapted to certain environments and could not live if the essential conditions were changed, but every form of life does not of necessity reach every region suited to it. Natives of one country when carried to another frequently develop with amazing rapidity, even to the extent of crowding out indigenous species. In the tropics, the forests contain a variety of forms and the large animals live singly or in families. In the temperate zones many plants and animals for mutual protection are gregarious. Forests often contain only one kind of tree and the variety is never great. Grasses do not grow singly as in hot climates, but form a sod. Animals move in herds and fish in shoals.

Natural distribution has been greatly modified by man. In some regions the large land animals have been exterminated and vast forest tracts have been removed. Domestic animals and cultivated plants have replaced the native species. Man alone of living creatures is able to rise superior to his environment, to conquer and control adverse geographical conditions. This faculty is acquired and is the result of long development. Primitive man was undoubtedly as helpless as other animals. The same sort of barriers that retard the migration of species, have also affected the growth of nations and no thorough conception of history, which is a record of man's development, can overlook the fundamental importance of geography. It was not until the barriers were broken down and until isolation gave way to intercourse with other peoples that civilization made safe and permanent advances.

Political Geography deals merely with the distribution of the human race in different communities, but an intelligent study of the boundaries of states involves an acquaintance with natural geographical conditions and the history of the inhabitants. It has been proposed to divide history into three periods. The first, known as the Fluvial, includes the growth of nations developing in fertile river deltas, with such scanty means of intercourse as the streams afforded. The Mesopotamian nations of Assyria and Babylon, the Egyptians and the Hindus are well-known examples. As the sailor became more venturesome and skirted the shores of large inland seas, the Mediterranean period succeeded the Fluvial. Columbus and Vasco da Gama inaugurated the last, or the Oceanic period. Such a view is at least not inappropriate in tracing the development of commerce.

Commercial Geography is the most practical branch of the subject. It means a knowledge of the distribution of the world's products, of existing demands for these commodities and satisfactory means of transportation and exchange. The Phœnicians were the first great traders. Their horizon was practically limited by the shores of the Mediterranean, although they sailed beyond its confines and many of the goods with which their ships were laden were brought to Syria by caravans. The Phœnicians were succeeded by the Carthaginians and the Greeks, but the typical merchants of the Mediterranean class were the Venetians. Their supremacy in the world's commerce was unquestioned until, at the close of the 15th century, the Atlantic succeeded the Mediterranean as the highway of trade. The centre of the world's commerce then passed in succession from Portugal to Spain and then on to Holland, the Hanseatic towns and London. To-day commerce is not a monopoly, but is world-wide. In volume of trade the United States is surpassed by no other nation, but competition is keen and the successful merchant of the future must be well versed in that knowledge of which geography forms the basis.

The growth of commerce has been in direct ratio to the extent and rapidity of geographical discovery. Some of the conditions which are favorable or unfavorable to trade are quite obvious. An indented continental outline and navigable rivers reaching the interior are most desirable features. In these respects Europe and North America are fortunate. Asia also is penetrated by arms of the sea, but her largest rivers, like the northern streams of North America, are practically useless, because they are tributary to an inhospitable frozen sea. Africa has no breaks in its contour and its rivers reach the sea by dropping from a plateau. Though lying next to Europe it baffled both the curiosity and the greed of her adventurers until the latter half of the 19th century. South America is not wanting in inlets and her river systems are remarkable, yet very little is known of some portions of the interior. It becomes evident that latitude is an important factor in the case of both Africa and South America. The torrid heat, the burning desert and the deadly fever were obstacles which the African explorer dreaded. The stagnation of Amazonian regions in South America is also explained when their tropical position is considered. Aside from topography and climate, the character of the inhabitants has much to do with the success of commercial intercourse.

Commerce has expanded because man has been able to meet and to overcome natural obstacles. He has to a great extent eliminated time and distance by cutting canals through isthmuses, by connecting the shores of the oceans by continental railroads, by the substitution of steam vessels for those propelled by the wind and by girdling the globe with the telegraph. He has modified climate both as to rainfall and healthfulness by the planting or removal of trees and by drainage of the ground. By irrigation he has made the arid waste productive and fruitful. At the beginning of the 19th century, the merchant was obliged to visit the region in which he desired to purchase his commodities and to carry with him the money for payment. Now, by the aid of a cosmopolitan system of credit, he may within a few hours buy in one part of the globe and sell in another without leaving his office.

Bibliography.— Champault, P., 'Des Bases Méthodologiques de la Géographie Humaine' (*Revue de Philosophie*, Paris 1914); 'Grande Geographie Bong Illustrée' (Paris 1911–14); Markham, C. R., 'The History of the Gradual Development of the Groundwork of Geographical Science' (*Geographical Journal*, London, 1915); Mill, H. R., as editor, 'The International Geography,' by 70 authors (New York 1912); Suess, E., 'La Face de la Terre' ('Das Antlitz der Erde,' trans. and annotated by Emm. de Margerie, Tome III, 2° partie, Paris 1911, and other parts and dates).

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GEOGRAPHY, Biblical, embraces the extent of the earth's surface known to the Biblical writers in Biblical times, and also the views commonly held during the Biblical ages relative to the shape of the earth and to the problems of its relation to the rest of the universe. There is no reason to believe that the Jews were more advanced in their geographical knowledge than were the Egyptians, Greeks, Romans and other civilized peoples of their own time. As there are no Biblical writings extant which furnish a statement as to the views held by pre-Christian Jewish writers, these views must be gathered from allusions, statements and other incidental information of a like nature scattered through Biblical literature. The view certainly seems to have been held that the earth stood still and that both the sun and the moon made daily journeys across it. The earth seems to have been regarded as a great disc bounded by a very distant horizon beyond which was the great primæval ocean. This surface was thought to be divided into four equal parts, each one of which was known as one of the quarters of the earth. The ends of these quarters, that is, the parts bordering on the primeval ocean, were known as the four corners of the earth. Another view held of this latter expression is that the "four corners of the earth" were the extreme points of the imaginary lines dividing the earth into quarters.

Josephus, speaking of the Garden of Eden, says: "The garden was watered by one river running round about the whole earth and which was parted into four parts." This is evidently the early conception of the earth itself surrounded by the primeval ocean from which ran the four rivers. This is suggestively like the Biblical narrative which states that the river of Paradise, after watering the celestial regions, divided itself into four sources from which sprang four great rivers. This would seem to indicate that the original conception of the Garden of Eden was that of a great land, perhaps the whole surface of the earth, which was divided into four sections by rivers springing from the primæval stream or ocean. In the course of time this cosmic myth seems to have become localized among the Jews and to have been given a tribal signification applied to a certain restricted spot which was the scene of man's creation, first years on earth and fall from favor in the eyes of the Creator. But while the description of the Garden of Eden was thus a restriction of the cosmic myth to a certain locality and race, there are evidences that the myth itself as known to the Greek, Romans, Egyptians and other peoples of Biblical days, continued long to represent the Jewish idea of the form and relationship of the earth.

In later Biblical literature the earth is still represented as "founded upon the seas and established upon the floods" (Psalms xxiv, 2). Above the earth stretched the firm and everlasting heavens, the abode of the Creator who planted his footsteps on the storms and used the earth for his footstool.

The four quarters of the earth seem to have retained, even in later Biblical days, among the Jews their designation as the home of the four winds; but how much of the primitive mythological conception went with this partition at this later date, it is hard now to determine owing to the difficulty of ascertaining when the writer is using imagery called out of the past, and when he is using the beliefs current in his day. The last seems to have been ever the primal direction from which all other directions were taken. In primitive myth it was the source of light and life. Therefore the eastern division of the earth was symbolically sacred. This is why temples, among many peoples, were always so constructed as to face to the east. This governed the manner of naming the directions of the compass which were designated as the direction before (east), the rising; the direction above, or to the left (north); the direction below, or to the right (south); and the direction behind, or the going down (west).

Definite Knowledge.— The Hebrews had a definite knowledge of their own land and of those of the races neighboring on their's; but beyond this their knowledge seems to have been very imperfect, even of the great nations of their day. Away to the north, according to Hebrew statement or description, stretched the great Euphrates. There, too, lay Assyria and Babylonia. But as to the extent of these and what lay beyond them, little or no information is furnished in Biblical literature. The land to the south was a general designation of Egypt, whose exact position, boundaries and extent are not indicated. This lack of detailed information is evidently not due to a want of geographical terms in the Hebrew tongue with which to describe in detail these various foreign lands, since the minutest descriptions are found in connection with localities intimately known to the writers. The conclusion is, therefore, that geographical knowledge of foreign countries was both limited and indefinite among the Hebrews in Old Testament times. Their knowledge of local geography was requisite owing to the tribal divisions among the Jews and the close relationship of the tribes with one another. These relationships produced a large vocabulary of exact, definite and comprehensive technical terms; and these seem to have been increased and perfected through contact with the

Egyptians. Even the indefinite conception of distant countries of the Hebrews was not far-reaching. The eastern end of the Mediterranean Sea, Egypt, Babylonia, Assyria, the Land of the Medes and the Persians, are presented more or less distinctly; but before the countries lying beyond these the curtain is generally drawn, or at the best, one corner is slightly turned back revealing uncertain glimpses of mysterious, indistinct lands within. Even this is more extensive than the geographical knowledge possessed by the patriarchs before they came into contact with Egypt. It follows, therefore, that the Hebrews had no real conception of the extent of the earth, the centre of which was, in their conception, their own land, and in later days, Jerusalem.

The limited geographical knowledge possessed by the Hebrews in earlier days was extended through contact with neighboring nations voluntarily or forced. The Babyonian captivity was the first event that seriously turned the national vision outward and made the Hebrews intimately acquainted with a powerful neighboring nation, thus broadening very greatly their geographical vision and giving them intimate knowledge of Assyria, Babylonia and Media, which formed one great commercial centre. The Hebrews also had an indefinite knowledge of the «Isles of the Gentiles,» gathered, undoubtedly, from their venturesome neighbors, the Phœnicians, who were well acquainted with all the countries on the shores of the Mediterranean. This knowledge tended to become somewhat more definite as time went on, and as the Hebrews became a more mercantile race and more of a political factor in western Asia. In later Biblical days, they acquired a much more definite geographical knowledge of all Asia-Minor and all the northern and eastern shores of the Mediterranean to beyond Italy. This again was steadily extended, until their position as a trading people about the beginning of the Christian era would warrant the belief that they possessed as wide a knowledge of the known world as was then held by people of the most advanced nations. This belief is confirmed by the fact that Syria was closely connected with Rome, and that the Hebrews, having been carried so often into captivity, and having been forced into commercial life, had begun to spread over the known civilized world and to become active in all the great centres of population. There is, therefore, a very considerable difference between the geographical knowledge possessed in Old Testament and in New Testament times. The eminence of Jews in literature among the nations in the century preceding the beginning of the Christian era, and in several centuries following, is eloquent of this wide distribution of the race at this comparatively early period. Yet, with all this wide distribution the Jews have left no early work on geography; though there is good reason to believe that works of this kind existed among Greeks, Egyptians, Phœnicians, and Romans. However, the first attempt at Biblical Geography was probably the 'Onomasticon' of Eusebius and Jerome, which was little more than an alphabetic-descriptive list of places. It was not until some time in the 17th century that Samuel Bochart, a French Protestant clergyman, wrote the first systematical account of Biblical geography. ('Geographia Sacra'). After this Wells, Reland, Dr. Robinson, and Ritter followed, each successively treating the subject from his own point of view. Yet each of these works, in some one or more respects, falls short of what a good Biblical geography ought to be, especially from the historical, philological and mythological points of view.

GEOLOGICAL SOCIETY OF AMERICA, an organized association, the outgrowth of the geological section of the American Association for the Advancement of Science. The society has a membership of about 365; it holds one general meeting annually, and publishes — also annually, but in four quarterly parts — its valuable *Bulletin*, a single serial octavo, the edition limited to 700 copies. The organization of the society having been completed in 1888, the first volume of the 'Bulletin' was dated 1890, and in this the object of the society was declared to be the promotion of the science of geology in North America. Article V of the provisional constitution provides that «The annual meeting shall be held between Christmas and New Year, at a place to be designated by the executive council.» Provision was also made at that time for special meetings.

GEOLOGICAL SURVEY, United States, a bureau of the Interior Department created for the purpose of preparing a map of the United States, classifying the public lands, examining the geological structure, mineral resources and the products of the country. To these duties were added those of investigating the extent to which the arid lands of the West can be redeemed by irrigation, segregating the irrigable from the nonirrigable lands, and the selection of sites for reservoirs and canals for the purposes of irrigation. The maps made by the Geological Survey are all on a large scale, and have a degree of accuracy and a minuteness in detail incomparably greater than ordinary maps. The smallest scale is 1-250,000, or about four miles to the inch, and this scale has been employed for regions of the West which are thinly settled, and where the topography is mountainous. But it has been superseded by scales of 2 miles and one mile to the inch, the latter for populous regions with slightly or moderately diversified topography, like Massachusetts and New Jersey. The maps are engraved on sheets which, with the 4-mile scale, embrace 1° of latitude and 1° of longitude. The 2-mile maps embrace tracts of half the above linear or one-fourth the areal dimensions; the 1-mile maps embrace one-fourth of the above linear and one-sixteenth the areal dimensions. The topography is represented by «contours» or «grade curves»; that is, by lines of equal altitude above the sea. The contour intervals are uniform for each sheet, but vary in different sheets according to the character of the country. In some tracts the contour intervals represent a difference of elevation of 200 feet, these being in very mountainous countries, while in flat countries and on large-scale sheets they may be as small as 20 feet. The general construction and methods of all maps are, however, the same.

There are three principal branches of the geological survey: (1) Geology proper; (2) topography; (3) irrigation surveys. The geological branch investigates the stratigraphy, the geological structure and history, the lithology, mineralogy and palæontology, the ores and mines, and in general the natural economics, resources and physical geography of the country. The topographic branch prepares the maps; the irrigation branch investigates the possibilities of irrigation and selects the irrigable lands and sites available for reservoirs and canals. The work of the topographic branch is the basis of the work of the other two, and all the results of the latter are projected on the maps. The publications of the survey are: (1) the annual report of the director, which, besides the administrative report, contains memoirs on geologic subjects by members of the survey, and is distributed according to the regulations of the Interior Department; (2) monographs on the leading subjects of special investigation by the geologists; (3) bulletins on more limited special subjects of research; (4) an annual volume of mineral statistics. The last three are distributed gratuitously only to designated libraries and to learned corporate societies, which send their own publications in exchange. Otherwise they are sold by the director and the money deposited in the treasury. See GEOLOGY; IRRIGATION; TOPOGRAPHY.

Methods and Publications.— The preceding paragraphs state in a general way the functions of this Survey as originally defined by Congress, together with subsequent modifications which included within the scope of its duties the study of the hydrographical conditions relating to water power, and to the irrigation of the arid lands of the western States.

As the geologic and hydrographic work depends upon the topograhpic work, the preparation of a suitable topographic map received primary consideration, and the general lines of operations extended to secure it were very definitely outlined from the earliest period of the Survey, so that at the present time almost the total area of the United States, exclusive of Alaska, has been surveyed and mapped for this purpose.

In the execution of the field work the procedure has conformed to the general methods employed in accurate trigonometrical surveys; but the enormous extent of the territory surveyed; the great diversity and the peculiar arrangement of the natural features of the country, and the necessity for executing the work as expeditiously as possible, and yet consistent with all the requirements of thorough accuracy, have tended to develop methods which are not only specially applicable to the work of the Survey, but also form a group of comparatively new methods available for any other line of topographical work. These methods may be briefly outlined as follows:

The surveying and mapping operations conform to the general plan which divides the whole area of the country into a series of quadrangles each of which is equal to a square degree, that is, each quadrangle is bounded on the east and the west by a degree of longitude, and on the north and the south by a degree of latitude.

The surveying operations consist in the extension of a system of primary and secondary triangles with tertiary triangulation points over the whole country, accompanied by three systems of level lines, supplemented by a system of road and stadia traverse.

The primary triangulation has been planned for the control of the work over the whole country, thus insuring the accurate ultimate meeting of fragmentary surveys which may be initiated a hundred or even a thousand miles apart. In this work, the triangles are expanded from accurately measured base lines, and connect various points of reference the geographical positions of which have been accurately determined by the most approved astronomical methods. The astronomical work consists of (1) the measurement of the zenith distances of stars by means of delicate zenith telescopes, for the determination of latitude; (2) the exchange of telegraphic time signals between unknown astronomical positions and a known astronomical position, such as a first-class observatory, for the determination of the differences of longitude; and (3) the observation of circumpolar stars for the determination of the azimuth of a line, such as a base line, or the side of a primary triangle. The base lines are measured by means of base bars, iced bars, or steel tapes, proper allowances being made for sag, pull, etc., and the measurements repeated several times in order to reduce the probable error to a minimum of less than one in 1,000,000. The elevations of the various stations are established by lines of precise levels run from the datum of mean sea level determined by means of accurate tide gauges. The angles of the triangles connecting these stations are measured by means of theodolites equipped with high power terrestrial telescopes. From the data thus obtained, the lengths of the sides of the various triangles are computed and the entire system of triangulation plotted on the topographic map to furnish the primary control for the secondary detail.

The secondary triangulation is usually executed by means of the plane table, and new points located so as to give from one to three good tertiary triangulation points per square mile. The elevations of these points, usually hill summits, are determined by the measurement of vertical angles of elevation and depression, depending upon spirit levelling, while the lower relief of the country is determined by lines of secondary spirit levels run six miles apart with intermediate lines of flying levels run three miles apart with sufficient accuracy to allow them to close on the secondary levels within the limits of one or two feet.

Traverse Lines.— Where the country is covered with dense forests, or where the surface relief is insufficient for triangulation purposes, both the primary and secondary control consists of a system of primary traverses checked by primary triangulation locations, or by astronomically determined positions. These traverses are run by compass and plane table, and a secondary system of traverse lines consisting of odometer and stadia measurements of roads is interwoven with the plane table work. The data obtained from the secondary traverses is plotted upon the plane table sheets during the progress of the work, and is subsequently adjusted upon the final map between the check points established by the primary traverse, or by the plane-table triangulation, the distances between which are so short — one to four miles — that errors of location are scarcely perceptible upon map scales of one inch to one or two miles.

The work of primary triangulation and precise levelling is usually executed a season in advance of the topographic sketching, while the secondary triangulation, traverse work and lines of flying levels are immediately followed by the topographic sketching, both classes of work being done by members of the same party. The data obtained from the secondary triangulation and traverses is then plotted upon a sketch sheet. This data is of such a character that each sheet includes from two to five trigonometric locations; from four to eight inches of road traverse; and one or more instrumental elevations, per square inch. Equipped with a sketch sheet thus prepared, the topographer places himself at a point of known elevation and sketches on the sheet by eye with the aid of a hand level the plan of the contour line which passes through his position. In open country, the contours may be located in this manner quite accurately for a distance of half a mile in either direction from his position, corresponding to a total distance of an inch upon the sketch sheet. In wooded country where the figure of the contour cannot be seen beyond his immediate position, he proceeds by road carefully observing the variations of the slope, and determines the differences of elevation for short distances between check points by means of the aneroid, and sketches in the plan of the contour according to the data thus obtained. In cases where the number of accurately determined elevations are insufficient, more locations are fixed by vertical angulation, or by flying levels as the work of sketching progresses. In this manner a system of contours is built up along the roads and water-courses, and if the lines do not practically fill up the entire sheet, the topographer walks into the spaces within the road circuits, and by means of stadia lines for long distances, or by pacing for short distances, determines the positions of the contours required to complete the sheet. The sketches thus obtained are inked in, either in the field or at the office, and are then reduced to the scale of the final map by photography and form the copy for the engravers.

The great topographic map of the United States now being thus prepared by the Survey, is published in atlas sheets of aproximately uniform size, 16½ by 20 inches, on which the mapped area occupies a space 17½ inches in height, and 11½ to 16 inches in width according to the latitude. The division of land represented by an atlas sheet is called a «quadrangle,» and is always bounded by parallels of altitude and meridians. Although the sizes of the sheets are always the same, three different scales are employed in the mapping of the surveyed areas in order to serve different purposes and to suit various conditions. A scale of 1: 62500, very nearly one inch to one mile, is used for mapping the thickly settled, or industrially important sections of the country. The sheets on this scale cover an area of 15′ of latitude by 15′ of longitude. A scale of 1: 125000, very nearly one inch to two miles, is used for mapping the greater part of the country. The sheets on this scale cover an area of 30′ of latitude by 30′ of longitude. A scale of 1:250000, very nearly one inch to four miles, is used for mapping the desert regions of the western States, and gives sheets which include an area of 1° of latitude by 1° of longitude.

This map is printed in three colors and shows the following named classes of natural and artificial features: (1) *Water,* including seas, lakes, ponds, rivers, creeks, canals, swamps, etc., are shown in blue. (2) *Relief,* including mountains, hills, valleys, cliffs, etc., are shown in brown contours. (3) *Culture,* or the works of man, such as villages, towns, cities, roads, railroads, boundary lines, etc., are shown in black. The features shown in blue and black are self-explanatory. In the case of the brown contour lines, each contour passes through points which have the same altitude above mean sea level, and a series of such lines arranged one above the other at regular vertical intervals, but appearing on the map at irregular intervals, that is, close together where the slopes are steep, and far apart where the slopes are gentle, accurately delineates the general configuration of the country, and gives the elevations of all points above the level of the sea. The vertical interval adopted varies according to the character of the country mapped. In a flat country it may be as small as 10 feet, while in a mountainous region it may be as large as 200 feet. usually, every fifth contour is made heavier than the others, and is accompanied by figures giving its elevation above the level of the sea. The heights of many other points, such as the intersections of ordinary roads and highways, railroad crossings and stations, the summits of uplands, hills and mountains, and definite bench marks, are also given in figures which are placed close to the points to which they refer, and are correct to the nearest foot. Each sheet is designated by the name of a principal town, or the name of some prominent natural feature within the district represented, and the names of the adjoining published sheets are printed on the margins. Explanations of the various conventional signs used are printed on the back of each sheet, and materially assist in the reading of the map.

This topographic map is the base on which the facts relating to the geology and the mineral resources of a quadrangle are represented, and constitute the sheets of the Geologic Atlas of the United States published by the Survey. The price of the topographic sheets is five cents each when the number purchased is less than 100 copies, and two cents each when they are ordered in lots of 100 or more copies. In the Geologic Atlas the topographic and the geologic sheets of a quadrangle are bound together, and, accompanied with a textual description of the district represented, constitute a folio of the Atlas. These folios are sold for 25 cents each, except those that have received special treatment and are unusually comprehensive. The price of such varies according to the character of the information afforded, the number of the maps in the folio, etc. All communications relative to these maps, or any other publication of the Survey should be addressed to The Director, United States Geological Survey, Washington, D. C.

The accompanying map is a small portion of the Housatonic quadrangle which includes portions of Massachusetts, New York and Connecticut. It affords a general idea of the topographical treatment; but, being printed only in black and white, it fails almost completely to give a true idea of the actual beauty of the original sheet as printed in the three conventional colors already described.

The importance of the topographical and geological publications of the Survey cannot be overestimated. The maps form the basis of all the State and county maps of the United States published for commercial purpose. Their accuracy is such that they are readily available for use in connection with the preliminary work of railroad, canal and other surveys, and for purposes of verification in damage suits and other legal proceedings before the various tribunals.

It is true that the work of the survey costs the government hundreds of thousands of dollars annually, but the returns through the various industrial channels and through the development of the natural resources of the county, amounts to hundreds of millions.

This is especially the case relative to the work and publications of the Geologic Department, without which the high economical development of the mineral resources of the country would be practically impossible.

In the matter of the use of instruments, such as the plane table, stadia and tape, and in the application of precise but rapid methods in the execution of the particular class of surveying practised, the various publications of the survey set the standard for this country and are invaluable not only to the student-engineer, but also to the actual worker in the field. These publications may be obtained by application to the Director of the Survey at Washington, D. C. Consult Branner, J. C., 'The relations of the State and National geological surveys to each other and to the geologists of the country' (Salem 1890); Johnson, D. W., 'Field methods in physiographic geology' (Lancaster 1913); Lesley, J. P., 'The utility of government geological surveys' (Philadelphia 1874); Hayes, C. W., 'The State geological surveys of the United States' (Washington 1911); Wood, G. M., 'The principal faults found in manuscript submitted for publication by members of the United States Geological Survey' (Washington 1906).

Portion of Housatonic Quadrangle

Scale $\frac{1}{125000}$

Miles.

Kilometers.

Contour interval 40 feet.

Datum is mean sea level.

GEOLOGY (from Greek *ge*, earth, and *logia*, account). Geology is that science which treats of the history of the earth. It begins with the remotest periods and traces in orderly manner all those changes in structure, material and external form which our planet has undergone. The record is read from the rocks themselves and interpreted in the light of processes now known to be taking place. Among those processes earthquakes and volcanoes were early recognized as important by reason of their cataclysmic nature; but later and more detailed studies show that quite as important, perhaps vastly more so, are the unobtrusive activities of rain, wind, running water, glaciers, waves, tides, and even organic agencies.

In following out these processes it must be always borne in mind that they operate with exceeding slowness. Indeed it is only through the conception of a history enormously long, expressed in millions of years, that we can understand the truly stupendous character of the work accomplished. (See section on *Age of the Earth*). With this vast length of time emphasized in the thought it must be further borne in mind that the great changes of the geologic past have been produced for the most part by the operation of those forces now going on before our very eyes. For that reason, we study closely the changes now taking place in order that in their light we may properly interpret the records read in the rock pages of the geologic volume.

In its broadest sense geology is one of the most inclusive sciences. The life records of the past can be read only in terms of modern biology; the remoter history of the earth's beginnings are inextricably interwoven with astronomy; physics and mechanics must be invoked to explain tides, interior rigidity, earth heat, and many other problems; the ultimate analysis of the materials of which our globe is composed must be referred to the chemist, as must also many of the changes involved in weathering and metamorphism to be detailed later; meteorology and climatology furnish the only rational background for the adequate study of those external forces now modifying the earth's surface. And so in nearly every respect it is seen that geology overlaps other fundamental sciences.

Geology Subdivided

Geology covers an extensive territory and is usually subdivided into the following more or less generally recognized branches.

Cosmic Geology treats of the origin of the earth, its relations to the other bodies of our solar system, and its general relations in space, thus encroaching on the field of astronomy. See Cosmogony.

Geognosy treats of the materials of which the earth is composed, air, water, and solid crust, known as the atmosphere, the hydrosphere and the lithosphere.

Mineralogy includes a study of the chemical composition, crystal form, origin, and occurrence of the large number of definite chemical compounds (minerals) of which the earth is made up. *Optical mineralogy* deals with the study of the optical properties of minerals with the polarizing microscope.

Petrology treats of the origin, occurrence, constituent minerals, and texture of the rocks of the earth.

Petrography, used loosely as a synonym for petrology, is in reality a more restricted term applying to a study of the structure, texture, and composition of rocks either macroscopically or microscopically, but not concerned with origin or occurrence. In later usage there is even a tendency to restrict petrography to microscopic study.

Lithology, formerly used in the same sense as petrology, is beginning to be confined by many to the macroscopic study of rocks as contrasted with petrography. See Mineralogy; Metamorphic Rocks; Petrology; Rocks; Sedimentary Rocks; Etc.

Dynamical Geology treats of the forces which tend to change or modify earth structure or earth form. It details the agencies at work and the processes by which they operate. These forces are hypogene (internal) and epigene (surficial). Three great processes are usually recognized, gradation, diastrophism and volcanism. Gradation is surficial and due directly to the action of rain, wind, running water, glaciers, wave work, tides, plants and animals. Volcanism is internal and deals with great movements of fluid rock, the most striking exhibition of which is to be seen in volcanic phenomena. Diastrophism, also internal, treats of the movement and distortion of rock masses (deformation) which the earth's crust undergoes, and which are best known through the manifestations of earthquakes.

Structural Geology, also known as geotectonics, deals with the arrangement of the materials of which the earth is made up. Its province is to investigate the origin of these structures and their practical importance in applied geology. It has to do with the causes of layering or stratification in rocks, the origin of folds and dislocations, and other problems of similar nature.

Physiography (geomorphology), now generally recognized as a science distinct from geology, deals with the origin and development of land forms, traces out the topographic expression of structure, and embodies a logical history of oceanic basins, and continental elevations; of mountains, plateaus and plains; of hills and valleys. Physical geography is used loosely as a synonym, but the term is more properly applied to the borderland between geography and physiography; dealing, as it does, largely with the human element as influenced by its physiographic surroundings. See Geomorphology; Physiography.

Paleontology treats of the life of the geologic past. It outlines the methods by which the evidences of that life are preserved in the rocks, traces in detail the development of various life forms, and attempts to correlate extinct with living genera. It overlaps the fields of botany and zoology, throws enormous light on the problems of evolution, and constitutes the real basis of all efforts to determine the relative ages and relations of strata in widely separated regions (Stratigraphic Correlation). *Palæobotany* is a sub-branch which deals exclusively with the palæontology of the plant world. See Fossils; Paleontology; Paleobotany; Petrifaction; etc.

Stratigraphy is not infrequently called historical geology though the latter term also properly includes paleontology. It is concerned chiefly in the working out of the history of past geologic ages. One of its problems, as has just been stated, is the correlation of strata in widely separated regions. Without this phase of geology little systematic advance in the science would have been possible.

Economic Geology.— Soil, water supply, mineral fuels and oils, building stone, base and precious metals;— all these and many other constituents of the earth have been widely exploited by man for his use. Economic geology deals with the application of geologic principles to this exploitation. It is concerned with the distribution, mode of occurrence, mineralogic content, and origin of these economically valuable substances. See COAL; ECONOMIC GEOLOGY; GOLD; SILVER; IRON.

Mining Geology.— There has grown up a treatment of applied geology particularly adapted to the mining engineer and known as mining geology. As one of its fundamental phases this obviously embraces economic geology. It also is concerned largely with structural geology, since the miner is interested likewise in the structure of the rocks in which the economically valuable minerals occur.

Glaciology.— Glaciers have been responsible for much modification of topographic form over large areas, and as detailed study of existing glaciers and glaciation and glacial phenomena in the past has increased, there has grown up a separate treatment of the subject under the name of glaciology. See GLACIER; GLACIAL PERIOD; PLEISTOCENE EPOCH.

Oceanography.— The publication of a vast mass of information resulting from several important deep-sea dredging expeditions has resulted in the development of this branch of the science to such proportions that many writers give it the rank of a separate branch of geology. See OCEANS; DEEP SEA EXPLORATION; CHALLENGER EXPEDITION; etc.

Metamorphic Geology.— Under the influence of favorable conditions in nature many minerals break down and their elements recombine to form new compounds. This process is very extensive and frequently results in the formation of entirely new rock types. The process by which one rock is altered into another is known as metamorphism, and the branch of geology which treats of the cause and nature of this change is known as metamorphic geology. See ROCK CLEAVAGE; METAMORPHISM; METAMORPHIC ROCKS; ROCKS.

DEVELOPMENT OF GEOLOGY AS A SCIENCE.

Probably the earliest geologic phenomena to cause comment were earthquakes, active volcanoes and floods. These were the cause of fruitful, if unscientific, conjecture among the earliest peoples who were wont to ascribe them to the vagaries of mythological monsters. Aristotle believed earthquakes were due to subterranean winds, and recognized a relation between them and volcanoes. Strabo followed in the same belief and going further was able to show the true nature of long dormant or extinct volcanoes. As early as the 6th century B.C. the presence of marine shells far inland was pointed to as an evidence that the land had been elevated from beneath the sea. Somewhat later it was affirmed that rivers eroded valleys and that land emerged from the ocean and was again resubmerged with exceeding slowness.

But these advanced ideas took little hold upon the mind of the time and during the Middle Ages the dominance of the Church with its insistent adherence to the exact letter of the biblical story of creation was a strongly deterrent factor in the growth of all scientific thought. The presence of fossils in the rocks was ascribed by some to Noah's flood. Others seriously taught that the Creator made many unsuccessful attempts before the right forms were finally produced, and that fossils were these rejected forms. Others even insisted that fossils were made by the devil to perplex the faithful.

Nicholas Steno (1631-1687) was one of the earliest observers to work out consistent geological theories. He developed the idea of the marine nature of fossils and showed evidences that the stratified rocks in which they occur are similar to marine sediments now accumulating. He advanced the idea that these rocks, where not now horizontal, must have undergone upheaval and deformation, and cited such folding as one of the chief causes of mountains. Steno had followers, but at best his ideas gained ground slowly.

Many wildly fanciful speculations have been advanced to account for the origin of the earth, but the first serious scientific attempt was made by Descartes about 1644. He conceived the earth to have been at one time a molten mass like the sun, which cooled down to the condition of a molten center with a solid crust. Thus he laid down the foundation of the now famous nebular hypothesis.

Guettard (1715-1786) was the first to make geologic maps showing the distribution of various rock formations and mineral deposits. He also did much to systematize paleontology. He published a work on the erosional effects of running water, citing many specific instances of its efficacy; suggested that the salinity of the sea was due to salts carried to it from the erosion of the land; and was the first to recognize the true nature of the group of extinct volcanoes in Auvergne.

In 1763 Desmarest, a Frenchman, made a careful study of the basalts of Auvergne, and by noting their intimate association with volcanic scoriæ became convinced of their volcanic origin. In this belief he was strongly opposed by Werner (1749-1817), professor of mineralogy and mining at the Freiberg Mining Academy, who was probably the first to attempt to work out a stratigraphic classification of the formations of the earth's crust, which he believed could be applied everywhere. It is essentially as follows: There existed a universal ocean from which the oldest or Primitive Rocks were chemically precipitated. As the earliest formations in the regions studied by him were granites, gneisses, basalts and other crystalline rocks, he assumed that these were of chemical origin. As the land gradually emerged from the universal ocean, erosion progressed and the Transition Rocks were mixtures of mechanical sediments with the Primitive series. As the waters became still further restricted mechanical deposits predominated to which he gave the name Floetz Rocks. These in turn were followed by the Alluvial series or recent clays, sands and gravels. He maintained strongly the chemical origin of basalts, as did his followers, and around him grew up a school known as the Neptunists, who vigorously argued his beliefs. The adherents of the igneous origin of basalt were also organized into a school under the name of the Plutonists and the controversy between them was for many years a bitter one. Though Werner was an enthusiast, his rigid adherence to his own doctrines in the face of evidence to the contrary probably did much to retard real geologic advance.

Notable among the Plutonic adherents were Hutton (1726–97), and Playfair, one of Hutton's most ardent followers. They, however, gave most to geology in another field. The cataclysmic events of earth history are most striking and the majority of the earlier students of geology, including Werner, belonged to the school of catastrophism; that is, they placed most emphasis on those changes in earth history that were sudden or startling. Hutton and Playfair, on the other hand, while not the first to see the slow processes of geologic nature, were the first to give to these slow activities their just place in the science. The school they founded has been called the school of uniformitarianism and their ideas still dominate geology. Sir Charles Leyell (1797–1875) became the greatest exponent of this school.

Paleontology, the study of which was gaining in interest continually, received added impetus from the work of Lamarck (1744–1829) and Cuvier (1769–1832), the former of whom antedated Darwin, though less definitely so, in ideas of evolution. The final impetus to paleontology came in the Darwinian theory which is now inseparably linked with all paleontologic research. The first real application of paleontology to stratigraphic correlation was made by William Smith (1769–1839), who showed that it was possible to trace certain formations for long distances by means of the fossils they contained. This constituted the real beginning of stratigraphy as the science is now known. Following him Murchison and Sedgwick carried the idea much farther and succeeded by the use of fossils in working out the extremely complicated succession of older rocks in western England and Wales.

Erratic bowlders scattered over England, over most of northern Europe, and over a large part of northern United States and Canada, were the cause of much geologic speculation. It was variously conjectured that they were carried there by Noah's flood, by rivers now extinct and by icebergs floating in an ocean much more extensive than that now existing. Playfair first suggested that they might have been transported by glaciers, but it remained for J. L. R. Agassiz (1807–73), whose studies of Swiss glaciers well fitted him for his task, to demonstrate glacial efficiency in the transportation of such bowlders. He is quite properly called the father of glaciology.

In this brief sketch of the development of the science, many important names have necessarily been omitted. Attention should be called, however, to those institutions and societies now actively furthering the science. Practically all large universities have departments of geology engaged not only in teaching but in research as well. Most of the civilized nations of first rank and many provinces, states and colonies maintain geological surveys whose major work is directed to the economic aspects of the subject. Most notable among such organizations are those of the United States, Canada, Great Britain, Germany and France, though many others are doing effective work. In the United States all but a few of the individual States maintain surveys. These organizations all publish the results of their work, usually for free distribution.

Cosmical Geology.

Cosmical geology, or cosmogony, brings out certain harmonies in the solar system, namely, that the orbits of all the important planets are practically in the same plane and nearly, though not quite, circular; that they all revolve in the same direction in their orbits; that most of them rotate in the same direction on their axes; and that these peculiarities of movement are shared by most of the satellites. These harmonies have led to the widespread belief among astronomers in a common origin for all the bodies of the solar system. Many theories of origin have been advanced, but only two are considered of sufficiently serious importance to be outlined here. See ASTRONOMY; LAPLACE; NEBULÆ; SOLAR SYSTEM; etc.

Nebular Hypothesis.— This theory, known also as the Laplacian hypothesis, has had more widespread acceptance than any other. It postulates a slowly rotating gaseous nebula, very tenuous, with its centre at the site of the present sun and so expanded that it filled all the space now occupied by the solar system. The nebula was supposed to have cooled and shrunk, the rapidity of rotation increasing with the cooling. Centrifugal force caused a bulging at the equator, with the final separation of an equatorial ring which further cooled and contracted until it broke and condensed into a planet. Several such occurrences in turn gave the several planets while the remaining portion of the parent nebula constitutes the sun. In a similar manner the planets gave off satellites. The molten earth is then supposed to have undergone progressive cooling, resulting in the formation of a solid crust. Certain mechanical difficulties inherent in the theory, but much too abstruse to be considered here, finally led Chamberlin and Moulton to the formulation of the following theory.

Planetesimal Hypothesis.— In brief the elements of this hypothesis are as follows: There are known to be in the heavens a large number of spiral nebulæ consisting of a main or central nebular mass and two curved or spiral arms in which are smaller nuclei or knots of varying sizes within a nebular haze. Each separate solid particle of matter is considered as a planetesimal (little planet) and the particles in such a nebula are supposed to have finally gathered together by overtake collisions while pursuing slightly different orbits. The central core became the sun, larger knots became planets and smaller knots became satellites, by gradual infall of solid planetesimals.

Under the nebular hypothesis the earth, once a molten mass, underwent progressive cooling until a rigid crust formed, perhaps over a still molten interior. It was not until this crust became rigid and at least moderately cool, that oceans could form and the ordinary geological processes go on. Under the planetesimal hypothesis, the earth was never molten, probably never very hot. As soon as it grew to sufficient size to have the necessary gravitative attraction, an atmosphere gathered, oceans formed, and the agencies of gradation began operation. The history of our earlier geologic eras thus would differ greatly in the minds of adherents of these two opposing hypotheses. See COSMOGONY.

Geognosy.

Geognosy, already defined may be treated under the topics atmosphere, hydrosphere and lithosphere.

The Atmosphere may be considered as a gaseous envelope entirely surrounding the earth and penetrating into the pores of the outer crust. It consists essentially of 79 per cent nitrogen and 21 per cent oxygen. Carbon dioxide (CO_2) makes up about 0.03 per cent, and water vapor, dust and rare gases are present in variable but small amounts. Nitrogen is very inert; but the oxygen, carbon dioxide and water vapor are all geologically active agents, the activities of which will be further discussed under dynamical geology, in the section devoted to the work of the atmosphere. See Atmosphere; Wind; Meteorology.

The Hydrosphere, including the waters of the oceans, lakes, rivers and underground circulation, constitutes a second but only partial envelope surrounding and penetrating the earth's crust. Geologically such waters are important agents both chemically as solvents and mechanically as a means of erosion, of transportation of sediments and of deposition. These activities will be more fully treated in the section devoted to dynamical geology under the topics of ground water, running water, oceans and lakes. See Rivers; Ocean; Lake.

The Lithosphere is the solid crust of the earth. For the most part it consists of a few common chemical elements in great abundance and a great many rarer elements in extremely minute quantities. Below are given the eight leading elements in the order of their abundance.

Oxygen	47.07	Calcium	3.44
Silicon	28.06	Potassium	2.45
Aluminum	7.90	Sodium	2.43
Iron	4.43	Magnesium	2.40
Total			98.18

It will be noted that the only useful metals in the list are iron and aluminum. Aside from these eight all the remaining known elements together make up less than 2 per cent of the crust. Estimates express zinc, tin and lead in the third or fourth decimal place, copper in the fourth or fifth, silver in the sixth or seventh, and gold in the seventh or eighth. (See Chemistry). These elements are combined in various ways to make up a large number of minerals, the most abundant of which are the feldspars, quartz, the pyroxenes, the amphiboles, the micas, calcite and kaolinite. Such minerals are definite chemical compounds. See Feldspars; Mineralogy; Quartz; etc.

These minerals aggregated mechancally in varying proportions constitute rocks, which differ from minerals in not having a definite chemical composition. Three great classes of rocks are recognized. Certain ones of these, known as igneous, have cooled and solidified from a hot fluid mass called a magma. The igneous rocks are further subdivided on a two-fold basis, that of mineralogical content and that of texture. No attempt can be made here to outline the classification. Suffice it to mention granite, syenite, diorite, gabbro, rhyolite, diabase and trap as among well-known igneous rocks. (See Rocks; Igneous Rocks; Petrology; Granite; Gabbro; etc.). Another great group of rocks are those laid down as deposits or sediments by water, wind, or glacial ice. They are usually stratified and are called sedimentary rocks. These may be further classified as aqueous, eolian and glacial; or as chemical, mechanical and organic. The common types are sandstone, shale, limestone and conglomerate. Sedimentary rocks are usually said to be derivative, inasmuch as they have all been developed by the weathering of igneous rocks by processes to be outlined under dynamical geology. (See Rocks; Sedimentary Rock; Sandstone; Shale; etc.). Both igneous and sedimentary rocks, by undergoing great heat and pressure or shearing stresses, may be altered (metamorphosed) to other rocks. Such altered rocks either of igneous or sedimentary origin are called metamorphic rocks, the most common types of which are marble, slate, quartzite, schist and gneiss. (See Rocks; Metamorphism; Marble; Petrology; etc.). Clays, sands and gravels, though unconsolidated are considered rock by the geologist and so classified. To this unconsolidated surficial material usually denominated soil is often given the name mantel-rock or regolith, as distinguished from solid rock or bedrock. See Soil.

Interior of the Earth.— The above description applies to what is usually known as the crust of the earth, that is, the outer shell of a few miles regarding which information is available. Concerning the interior of the earth, sometimes called the pyrosphere or the centrosphere, little is really known. It was long thought that the interior was molten, the belief being based on the extrusion of lavas, the existence of hot springs and the known rate of increase of temperature in deep mines. But it is a well-known principle that for most substances increased pressure increases the melting point, and it is quite possible that the enormous pressures prevent the rocks from becoming molten. The rigidity of the earth has convinced physicists that, whatever its temperature, the interior acts as a solid mass. Of the composition of the interior next to nothing is known. The fact that the earth as a whole has a higher specific gravity than its surface rocks has led many to suppose that the interior consists of very heavy minerals or metals, perhaps iron, or even precious elements. This, however, is mere speculation.

Dynamical Geology.

The surficial forces of dynamical geology will be discussed under the process of gradation, the internal forces under the processes of diastrophism and volcanism.

Gradation.— The external forces are continually at work tearing down earth structure at one point, building up at another. This tearing down and rebuilding is known as gradation. Degradation, erosion and denudation are practically synonyms for the tearing down process; aggradation and deposition for the building up. The first step is the reducing of rock material to fine particles ready for removal and is known as weathering. The removal of the material is known as transportation, and both steps are subprocesses of erosion. The main agents by which these processes are carried on are the atmosphere, ground water, running water, oceans, lakes and organisms.

The Work of the Atmosphere is both mechanical and chemical. Mechanically, it works by means of wind, frost, sudden temperature changes and rain impact; chemically, by oxidation, carbonation, hydration and solution.

Wind work is everywhere operative but is much more effective in arid than in humid regions. Deserts are especially exposed to its activity, due to lack of vegetation, which in humid regions forms a protective cover. Wind laden with drifting sand is an important agent of erosion. Rocks of uniform hardness are worn smooth, rocks that are less homogeneous are etched into relief by the cutting away of softer parts, cliffs are undercut and desert regions are thus rendered famous for their fantastic forms. Desert sands are in many places strewn with highly worn and polished pebbles which represent the harder particles of rock left behind after the softer rock is ground fine and blown away. Wind also has a notable transporting power. At no time is the air free from fine dust. Falls of dust and volcanic ash on ships at sea and films of dust on unbroken snow fields of high altitudes testify to the carrying power of even moderate breezes. The great sand and dust storms of arid regions are well known. On the margins of deserts thick and extensive deposits of wind-blown soil called loess occur. Famous loess beds occur in China and in the United States, in the latter particularly along the lower courses of Missouri and Mississippi rivers. Wind-drifted sand accumulates in hills whose gentle slopes are toward the wind. Because sand drifts up the incline and slides down the steeper lee slope, such sand dunes continually migrate in the direction of wind movement and not infrequently encroach upon arable land causing destruction of property. As a result of such damage much has been done in the study of the prevention of dune migration. Wind-blown material of this sort may become buried, ultimately consolidated and finally form sedimentary rocks. Eolian deposits are called terrestrial or continental, as opposed to marine deposits laid down in the sea. Wind also influences climate and rainfall, controls waves and currents and acts in many ways as an indirect geologic agent. See DESERT; DUNE; EOLIAN DEPOSITS; LOESS; METEOROLOGY; WIND; etc.

Freezing water exerts an expansive force of about 2,000 pounds to the square inch. Water in minute pores of the rocks, or in larger openings such as joints or bedding planes, is an efficient agent of disintegration in those latitudes and at those altitudes subject to sudden and repeated freezing and thawing. It crowds and wedges off large angular blocks from every exposed ledge. The great talus slopes of mountain regions afford well known illustrations. See FROST; ICE; TALUS; etc.

If a rock be heated in a campfire and dropped into cold water, the sudden contraction of a rapidly cooling exterior over a still heated interior causes the disruption of the mass. A similar phenomenon takes place in desert regions where, due to lack of moisture and protecting vegetation, the daily range of temperature is extreme. In the Sahara the daily range is said to be over 100° F., and explorers state that at night there may frequently be heard the report of breaking rocks. A rock like a granite made up of several different minerals is more subject to such disintegration than a sandstone which is homogeneous in composition. This is because the different minerals expand at different rates upon heating and tend to tear asunder. Change of temperature usually results in the breaking off of curved concentric masses of rock, hence the term exfoliation is sometimes applied to it. See DESERT; EXFOLIATION; etc.

In soft rocks, the impact of falling rain drops, entirely aside from any erosive effect of running water, has a disintegrating action. This is usually effective only in regions of light vegetation, and is therefore most strikingly exhibited in our so-called "bad lands." (See BAD LANDS). The above forces are wholly mechanical in their activity. They are for the most part agents of weathering, and only in the case of the wind are they important in transporting or depositing soils.

The chemical work of the atmosphere will be described briefly under the topics of oxidation, carbonation, hydration and solution. Oxidation is the union of some rock element with oxygen. The affinity of ferrous iron and sulphur for oxygen is a familiar fact and the group of sulphur bearing minerals (the sulphides), particularly pyrite and chalcopyrite, as well as many minerals containing ferrous iron, especially the so-called ferro-magnesian minerals of which the pyroxenes and amphiboles are examples, are subject to oxidation. The iron ultimately forms hematite or limonite and the sulphur becomes sulphuric acid. This process of oxidation is of great economic importance in the secondary enrichment of sulphide ore bodies. See CHALCOPYRITE; ECONOMIC GEOLOGY; MINERALOGY; OXYGEN; PYRITE.

Carbonation consists of the union of some element in the rock with carbon dioxide, to form a carbonate. The most common carbonates are those of lime, magnesia, iron, potash and soda. The feldspars, aluminum silicates of lime, soda and potash, are the minerals most influenced by carbonation. The lime, soda and potash combine with carbon dioxide from the atmosphere, are set free as carbonates and usually go out in solution. The alumina remains combined with part of the silica to form the mineral kaolinite, more commonly known as clay. This mineral is relatively insoluble, the clay remaining behind as a residual product. Some soluble (colloidal) silica is set free, which goes out in solution and ultimately is precipitated in the pores of the rock as cement, or in cracks as quartz veins. See CARBON DIOXIDE; FELDSPARS; MINERALOGY, etc.

Hydration is the taking on of water by certain minerals during the process of weathering. The common red oxide of iron thus becomes the hydrated brown oxide, limonite. The kaolinite above described takes on water during its formation. Hydration is usually accompanied by an increase in volume and a general weakening of the rock mass.

Even pure water dissolves certain very soluble minerals, but when charged with carbon dioxide or organic acids from decaying vegetation it has a much greater solvent power. Among the more soluble compounds often removed by solution are the carbonates mentioned above. Limestone (calcium carbonate) is weathered chiefly by solution, the carbonate dissolving away and the insoluble impurities remaining behind, usually as a flinty clay, the most common type of residual soil in limestone regions.

Mechanical weathering (disintegration) results merely in grinding up the rocks into finer particles of the same substance. Chemical weathering (decomposition) removes the soluble substances, chiefly the lime, magnesia, soda and potash, and leaves behind the insoluble substance as residual soil. This residue consists chiefly of sand, clay and iron oxide. All of our soils were ultimately derived from the weathering of rocks. As they consolidate, the sands form sandstone; the clays, shales; the gravels, conglomerates. The lime and magnesia are carried away to the sea, there to form limestone; the soda is taken to the ocean, there to become the salt of sea water.

Work of Ground Water—That there is much water in the pores of rocks far underground, is evidenced by the constant supply in wells and springs. Most of this seeps in from rainfall on the surface and is known as meteoric water. A much smaller part is believed to be given off from molten rock (magma) as it cools deep in the earth. This is called magmatic water, and, though probably of small amount, is believed to be of great importance in the formation of mineral veins. (See ECONOMIC GEOLOGY and ORE DEPOSITS). Most of the vast body of water thus derived is held in the minute pores of the rock, just as a pan full of sand will absorb nearly one-fourth of its volume of water, which is held in small openings between individual grains. There are few underground rivers and these are usually in limestone, a rock easily dissolved.

When a well is sunk a level is usually found, below which the ground is saturated. This level, known as the water table, is not an even plane, but follows roughly the surface irregularities, though in a less accentuated form. In valleys it is met at shallow depths, but under ridges it is not so near the ground surface. Its position is often modified by the porosity of the rocks, since some layers are so impervious that they let the water seep downward only very slowly. It is usually deep in arid regions. Ground water is in constant movement; above the water table the direction is chiefly downward, at the water table it is chiefly lateral as the water moves to its points of outlet in nearby valleys. Below the water table the movement is extremely sluggish and chiefly concentrated along fractures or through the more porous layers. Hot magmatic waters will move from deep seated magmas toward the surface. The work of ground water is mostly chemical since it moves too slowly to be effective in erosion.

Chemically, solution by ground water in limestone or gypsum results in caves, the action beginning along joints which gradually enlarge into passages and chambers. Waters trickling in from the roof and charged with calcium carbonate in solution evaporate and stalacites are built in much the same way as icicles are formed. They may be colored by various substances, and often assume great complexity. Waters dripping on to the floor of a cave build similar deposits known as stalagmites. Sink holes are formed by the collapse of cavern roofs, or by solution enlarging joints in limestone, allowing the soil to slump, leaving a funnel shaped depression. Sinks are rare in other than limestone regions. See CAVE; LURAY CAVE; MAMMOTH CAVE; etc.

Circulating ground waters carry much mineral matter in solution. This, where deposited in fractures in the rock, forms veins. The mineral matter may originally be derived from deep seated magmas brought up by magmatic waters, or it may be leached from adjacent or overlying rocks by either hot or cold meteoric waters. Precipitation may result from organic matter, from loss of heat, from decrease in pressure, or from still other causes. Many veins consist wholly of worthless substance, such as quartz or calcite, while others carry values in gold, silver, copper, zinc, lead, etc. A thorough knowledge of ground waters is essential in the study of ore deposits. See ECONOMIC GEOLOGY; ORE DEPOSITS.

Ground water is secured for human use by artificial openings known as wells. To have a constant supply a well must extend below the water table. Open-textured, porous rocks such as sandstones, conglomerates, and gravels form the best water-bearers (aquifers) from which the water usually seeps slowly into the well, though occasionally the supply comes from cracks and cavities.

Wells often are sunk from which the water flows without pumping. These are called artesian (from Artois, France). The word is often, but incorrectly, used for any deep well. The best usage now applies the term to any well even though not a flowing one, in which the water tends to rise by its own pressure above the depth at which it was encountered. The conditions necessary for artesian flow are described in a separate article. See ARTESIAN WELL; WELLS; WATER SUPPLY.

Any natural outlet for ground water is a spring. As a rule springs are most abundant in lowlands and valleys where the ground surface is nearest the water table. At any point, however, an impervious layer beneath a porous bed may prevent the downward seepage of water and deflect it laterally to outlets or springs. Most small springs are mere seepage from porous rocks or soils. Larger ones usually come from fissures, and some of the largest known like those in the Ozarks, flow from caves in limestone regions, and are powerful enough to furnish considerable water power.

Warm or hot springs are known in many regions. In some cases it is believed the heat is due to the great depth from which the water ascends along large fissures or faults. In other regions of recent volcanic activity the heat is probably derived from still uncooled masses of rock buried beneath the surface. Such are the hot springs of Yellowstone National Park. The temperature of the water in springs varies from the normal ground temperature to the boiling point. See SPRING; VOLCANOES; etc.

Geysers are a special variety of hot springs from which the water and steam are violently erupted at intervals more or less periodic. They are invariably found in regions of recent volcanic activity, and the two most noted areas are in Yellowstone National Park in the United States, and in Iceland. See GEYSERS; also VOLCANOES.

Work of Running Water. (Rivers).—Running water is the most important geologic agent in the shaping of land forms, though its efficacy was long unrecognized. In early times it was scarcely realized that valleys are carved by the rivers that occupy them and that most land forms are strongly modified by running water. This work can be divided into erosion (denudation or degradation) and deposition (or aggradation). Erosion includes the making of rock material into fine particles (weathering) and its removal (transportation).

There is a constant struggle between the internal and external forces of the earth. The former no sooner bodily raise a region out of the sea (see section on Diastrophism) than the latter tend to tear it down and carry it back. If given sufficient time any region, no matter how high it may have been elevated, will be reduced again to a featureless plain, at or near sea level. The level below which rivers cannot reduce a region is known as base-level and a region so reduced is said to be base-levelled or peneplained (made almost a plain). The complete history through which a region passes from the beginnings of the first drainage established on it after its emergence back to a peneplain only slightly above sea-level is said to constitute an erosion cycle. In the earliest stages of the cycle a few very crooked streams without valleys and with few tributaries accommodate the run-off from rainfall. Large areas are almost without drainage. Each stream, however, using the sand or gravel of its bed as tools, starts wearing its channel deeper and deeper until deep but still narrow valleys alternate with broad flat undissected divides. Undrained depressions are still occupied by lakes and the streams usually have falls and rapids because they cut more rapidly on soft than hard rocks, making their gradients very uneven. This stage is known as youth. As the valleys deepen, gullies are cut in their slopes and these enlarge into tributaries which work back until the entire area is dissected. There are no longer flat-topped divides but an intricate network of valleys, each carved by its own streamlet. The main streams have cut as low as they can and yet have sufficient gradient to flow to the sea. Even the harder rocks of their beds have been planed down and falls and rapids are almost worn away. Lakes are filled up with sediment or drained by the wearing down of the outlet. The region is now in maturity. Since the streams are now as low as they can erode, their chief work is to carry away the material which weathering and minor tributaries bring to them from the valley sides. The valley, though no longer deepening, is rapidly widening. Divides become more and more worn away until they are reduced to mere gentle swells. Each stream becomes sluggish, is easily deflected by obstructions, and begins to wind (meander) in great curves over a broad flat bottom known as a flood plain. In times of floods the curves are cut through and loop-shaped portions of the channel are abandoned and constitute oxbow lakes. The region, now in old age, is said to be base-levelled or peneplained. Youth, maturity and old age are only comparative terms to express how far a region has progressed in the erosion cycle. It cannot well be expressed in terms of years since a region on soft rock might progress to old age before an adjacent region on harder rock had well reached maturity.

Many factors tend to modify the apparent simplicity of the above history. When hard rocks overlie soft ones, the latter frequently wear back faster, causing an undermining of the hard projecting layer. Many cliffs are of this origin. When such a cliff lies athwart a river course a fall or rapid results which retreats upstream by undermining. A good illustration of this is Niagara, which is retreating about four feet a year. In arid regions where there is little precipitation erosion may go on very slowly. What rainfall there is, however, frequently comes in sudden storms and, as there is no protecting vegetation, may be very effective. (See DESERTS). Where the rocks are flatlying, or homogeneous, the familiar branching treelike or dendritic pattern of drainage results. Tilted layers of hard and soft rock frequently result in long parallel ridges and valleys, a pattern of drainage known as latticed or trellised. Streams working on the softer layers of rock have an advantage in that they cut faster and ultimately capture their less fortunate neighbors. (See STREAM PIRACY). Thus there is brought about what is known as structural adjustment or the close control of drainage by rock structures. Changes of level may take place at any stage of the cycle. A base-levelled region when uplifted enters upon a second youth, is said to be rejuvenated and may again pass through another cycle. Gradual depression of a region, on the other hand, tends to slow up erosion or even to inaugurate desposition.

The fine material furnished in the course of the erosion cycle by weathering and by the constant attrition of the stream itself is carried away by the running water, most of it to ultimately find its way to the ocean. Soluble carbonates, sulphates and chlorides are carried in solution. Calcium carbonate (limestone) is abundant in most river waters. Very finely divided clay or sand is carried in suspension and causes the turbidity of river water. Coarser sand and gravel are rolled along the bottom. The total amount of sediment carried by the rivers of the United States in a year is greater than the total tonnage of all our railroads. A most significant factor in transportation by running water is the sorting which the sediment undergoes. Because it is more easily carried, the finer material is borne away, the coarse left behind. If a residual soil from a granite consists of a mixture of sand and clay (see section on chemical work of the atmosphere), running water tends to sort the finer clay from the coarser sand and ultimately clay and sand come to rest in widely separated areas. Alternations of shales (consolidated clay) and sandstone (consolidated sand) in the rocks of any region are a resultant of the sorting power of moving water.

Where rivers emerge from mountainous regions and flow across plains the velocity is suddenly checked and deposits are built up, which, if steep, are known as alluvial cones, if low and flat, as alluvial fans. Alluvial fans are common at the base of practically all mountain ranges. Where several adjacent fans coalesce, the sheet of debris is spoken of as a piedmont alluvial plain, or sometimes as a mountain apron. Intermontane valleys in arid regions frequently fill to great depths by this process, because, since there is no drainage to the sea, all the material brought down by water from the melting snows is perforce lodged in the adjacent valleys. In the lower courses of many streams, as they pass from maturity into old age, the valleys become wide flood plains over which streams meander sluggishly and the velocity may not be enough to carry off the sediment carried down from the more vigorous upper reaches. Consequently broad sheets of fine sediment may be laid down over these plains. At their seaward edge these deposits grade into deltas, built by rivers in lakes or the ocean where the velocity is checked by quiet water. The delta plains of large rivers are low and swampy and like flood plains subject to frequent overflows. The soil is usually fine since the velocity of the stream in its lower reaches is not sufficient to transport coarse material. Flood plains and deltas, when they can be properly drained and protected against flood, are usually rich agricultural areas. See DELTA; FLOOD PLAIN; PHYSIOGRAPHY; RIVERS; TERRACE; etc.

Work of Glaciers.— Wherever more snow falls than melts perpetual snow fields occur and the snow may gradually be compacted till it becomes granular névé, as it is called, and ultimately pass into ice. If the accumulation becomes sufficiently thick it may begin a slow outward creep from the point of origin and become a glacier. In mountains these bodies of ice often occupy valleys and are termed valley or alpine glaciers. In polar regions they frequently spread over vast areas and are then spoken of as ice caps or continental glaciers. See GLACIER.

One school of glaciologists holds that glaciers erode powerfully carving out deep valleys and removing great masses of sediment; another believes that glacial modification of topography is not profound. Be that as it may, it is a well-known fact that the appearance of a region is much changed by the passage over it of a great ice sheet. As the ice, into the base of which are frozen sand and bowlders, scours over the rocks it scratches long parallel marks known as striæ which reveal the direction of movement. Rock hills and ledges (roches moutonnées) are worn smooth with the more gentle slope in the direction from which the ice came. Projecting spurs and promontories are truncated and valley bottoms rounded into characteristic U-shapes. By deepening and widening trunk valleys tributaries are left hanging high above the floor of the main stream, resulting in discordant junctions or hanging valleys. By freezing to the walls of the valley heads and plucking away the loosened bowlders, glaciers carve amphitheatre-like bowls, known as cirques.

As the glacier moves forward sand and bowlders frozen into or resting on the ice are carried for long distances. Since it is held rigidly by the ice, the material being transported undergoes no sorting, a marked feature of glacial as compared with river transportation.

Along the sides of a valley next to its rocky banks much material accumulates on the ice. These ridges are known as lateral moraines and when by the junction of two glaciers a moraine occupies a central position it is known as a medial moraine. After the melting of the ice these are rarely preserved as distinct ridges. More important is the material accumulated at the front of the glacier, when the rate of melting just balances the rate of advance and each bowlder brought forward is contributed to the growing mass, known as a frontal or terminal moraine. In the case of continental ice sheets such ridges of clay, sand and gravel may be traced for many miles. The material is usually unsorted and unstratified. Rounded elliptical hills of unstratified glacial debris with their longer axes in the direction of ice movement are known as drumlins. They are common in southern Wisconsin, central New York and the vicinity of Boston. Their cause is not well understood.

Much water, the result of melting, usually flows away from an ice front, tending to produce stratified glacio-fluvial deposits. A river flowing from the front of a glacier fills the valley bottom for miles with a valley train of stratified sand and gravel. Spread out in a broad sheet in front of the ice, such a deposit is called an outwash plain. Large blocks of ice are frequently buried in outwash plains and melt very slowly, the resulting depressions, often occupied by lakes, being known as kettle holes. Eskers, long, winding ridges of stratified gravel greatly resembling railroad embankments, are believed to be deposited by streams flowing in tunnels under the ice. Glacial deposits in general are known as drift and are classified as stratified drift, and as till or unstratified bowlder clay.

In regions that have been strongly scoured by ice the preglacial topography is largely obscured, the original drainage being entirely disarranged by the complete filling of the old valleys. Such a region shows many features of extreme youth, as lakes and swamps, falls and rapids. Bed rock where exposed may be striated and polished, and many erratic bowlders, foreign to the country, lie strewn everywhere, having been brought by the ice from distant regions.

It is known that several times in geologic history glaciers have been more widespread than now. During the Pleistocene most of Canada and a large part of northern United States south to the Ohio and Missouri rivers was covered by an ice sheet as was also most of northern Europe. During the Permian there was widespread continental glaciation in South Africa, Australia and India reaching into the torrid zone both north and south of the equator. Continental glaciation occurred in the Cambrian period in China, and probably during the Algonkian in Canada. See GLACIER; ALGONKIAN; CAMBRIAN; PERMIAN; PLEISTOCENE EPOCH.

Work of the Ocean.— Practically three-fourths of the earth's surface is covered by oceans, which have a maximum depth of about 30,000 feet, and an average depth of about two miles. Sea water contains 3.4 per cent of dissolved matter, of which about three-fourths is common salt, ($NaCl$) and about 0.3 per cent calcium carbonate.

Of all the movements of ocean water waves are geologically the most striking and their chief work lies in modification of the shore line.

Wave impact striking blows of 600 to 2,000 pounds per square foot and armed with sand and pebbles gathered on the shallow bottom may become powerful agents of erosion, wearing back steep shores with a constant tendency to undercut and form cliffs, grinding finer and finer the mantle of sand and pebbles on gentler beaches. The eroded material is gradually rolled and dragged out into deeper water by undertow and currents. Incidental to the erosion produced by waves are many peculiar shore line features such as sea caves, isolated stacks or pillars, natural archways and wave-cut terraces. Along the chalk cliffs of England and France the waves wear back the shore line in places at the rate of several feet a year. The island of Heligoland once very much larger than it is now has been nearly cut away by wave work. (See HELIGOLAND). Many geologists believe that such marine planation is even more important than river peneplanation in the wearing away of continental masses. The detritus formed by wave wear is drifted by the undertow or by currents parallel to the shore and built up into sand beaches. On gently inclined shores where the waves break some distance from land barrier beaches or islands often form. Aided by the work of the wind in drifting the sand into dunes, such barriers may effectually isolate bodies of ocean water which then become lagoons or salt marshes. These fill rapidly with vegetation which may form peat.

Shore lines are frequently modified by changes of level. Since the ocean bottom is not subject to erosion it is much less rough than land. An uplift would cause smooth ocean bottom to become land resulting in long straight coasts accompanied by beaches elevated far above the reach of waves. A sinking of the coast would allow the sea to enter many valleys and result in an extremely irregular shore line. See section on *Diastrophism*.

The material contributed to the ocean by rivers plus that worn from shore lines by waves accumulates steadily on the ocean floor, there to rest till uplift exposes it again to weathering and erosion. Along the littoral belt, that is, between the reach of highest and lowest tide, coarse gravel or sand is the rule, with here and there areas of finer muds near the mouth of some large river. Such sediments are likely to change rapidly from point to point and to show crossbedding and ripple marks. (See section on STRUCTURAL GEOLOGY). Further out in the shallow water belt the sediments become finer, the coarser material derived from the land settling out nearer shore. Beyond the gravels are sands and beyond these clays and muds. These deposits are much more constant in character than those near shore, with no such rapid changes in the coarseness or the nature of the material. Very minute lime-secreting animals live in this zone, where the waters are clear. Their skeletons settling to the bottom form accumulations of lime oozes that later become limestone, which may be interstratified with beds of clay or sand. Other oozes are also known. (See OOZE). Where the water is especially clear, coral polyps live both in the littoral and shoal water zones and build coral reefs and islands of large dimensions. (See CORAL AND CORAL ISLANDS). Little material derived from the land ever gets into the abysmal ocean. Insoluble windblown material largely of volcanic origin, meteoritic dust, and insoluble remains of marine organisms accumulate very slowly forming the red clays of the deep sea. Since it is believed that the ocean deeps have remained great deeps throughout much of geologic time, it is thought that these deposits are rarely exposed on land; but the shales (clays), sandstones (sands), and limestones (lime oozes) formed in the shallower ocean frequently are exposed by uplift, and a large proportion of our present sedimentary formations are of marine origin, in contrast to the eolian, alluvial, and glacial deposits already described, which are classed as terrestrial or continental. See BEACHES; LIMESTONE; OCEAN; SEDIMENTARY ROCKS; SHORE LINES, etc.

Work of Lakes.— Lakes are the result of imperfect drainage, and may be due to original depressions in the land surface as it emerged from the sea; to later obstructions of drainage lines by uplift athwart their course; to filling by glaciers; or to other factors. In humid climates most lakes have outlets which tend to lower by erosion, and this is a factor in their final destruction. More important is the filling of the basin. All lakes, because the water flows through them very slowly, act as settling basins and retain most of the sediment brought to them by streams. The depression soon becomes filled with mechanical, chemical or organic deposits and the lake ceases to exist. The mechanical sediments include clays, sands and gravels. As in the oceans, the coarser deposits form nearest shore, the finer out in deeper and more quiet water. Chemical deposits are characteristic of arid regions where few lakes have outlets. All the dissolved matter brought in by streams remains in solution until the water becomes so concentrated that the salts must be precipitated. Common salt, gypsum and limestone are usual chemical precipitates from lakes. (See GYPSUM; SALT). Many important beds of gypsum and much salt in the United States have been formed in this manner. Organically certain small plants known as Chara cause the deposition of calcium carbonate. Such accumulation are the most common source of marl in our northern lakes. (See MARL). Many water plants, especially sphagnum moss, accumulate and form peat (see COAL; PEAT; PEAT BOGS; SWAMP; etc.), which may ultimately become coal. Bog iron ore, chiefly limonite, accumulates, partly as a chemical precipitate, partly as the result of so-called iron bacteria. All deposits laid down in lakes are known as lacustrine in contrast to glacial, alluvial and eolian deposits. During geologically recent times lakes have existed that are now extinct. Their boundaries have been traced by the old beaches. The more noted of these lakes in the United States are lakes Agassiz, Bonneville and Lahontan. See LAKE; GREAT SALT LAKE; LAKE AGASSIZ; LAKE LAHONTAN, etc.

Work of Plants and Animals.— Organisms are important geological agents. Mechanically, roots grow in cracks and wedge rocks apart, trees blow over and expose fresh soil at the surface; earthworms, moles, and other burrowing animals bring soil to the open air.

Vegetation also acts as a cover preventing drifting of sand, erosion by running water, and the rapid heating and cooling of rocks. Chemically, decaying organic matter yields carbon dioxide and acids that act as solvents for mineral matter, and that aid in weathering. Accumulating vegetation forms peat and finally coal. Coral polyps secrete lime and build whole islands of coral rock. Limestone consists largely of the skeletons of minute lime-secreting animals and many other deposits are formed by organisms of one sort or another. Plant and animal remains embedded in the rock as fossils form the basis of most of our efforts to correlate rock layers and to divide geologic time into units. Man, by means of deforestation, irrigation and other activities, is coming to have control over geologic processes.

Diastrophism.— Diastrophism may be considered as the deformation of the earth by internal forces, the origin of which is not well understood but which are believed by many to be the result of the cooling and shrinking of the earth in its passage from the molten to the solid state. Others believe they are due to the settling of heavy wedge-shaped segments of the earth's crust (oceanic blocks) and the forcing aside and upward of lighter segments (continental blocks), since actual experiment with a pendulum seems to show that the specific gravity of the rocks under the oceans is greater than that of those under the continents. Be that as it may, it is a well-known fact that the earth's crust is undergoing almost constant deformative movements which are usually divided into two classes, epeirogenic and orogenic. See ISOSTASY.

Epeirogenic movements are those which involve the uplift of whole continental masses very slowly without appreciable folding or dislocation except gentle warping. Most of the great interior of the United States between the Appalachian Mountains and the Rocky Mountains consists of flat lying rocks varying from 500 to 2,000 feet above sea level. These rocks show conclusively by their character and fossils that they were laid down beneath the sea, and that they now occur at this elevation proves a broad extensive uplift. That such changes of level are still going on is best shown along sea coasts where elevated beaches and wave cut terraces and caves not yet obliterated by weathering testify to recent uplift. Such elevated beaches are known at several different levels along the coast of California. On the other hand, off the Atlantic coast the channel of the Hudson River can be traced many miles along the bottom of the shallow ocean across the continental shelf. There is not sufficient current to account for the erosion under water, and it seems practically certain that the channel was carved at a time when this shelf was land, and that the coast has since been submerged. There is abundant evidence that certain regions have been thus elevated and again depressed many times during their history. See BEACHES; CONTINENT; SHORE LINES; UNCONFORMITY.

Orogenic movements are mountain making, involving intense crumpling and dislocation of the rock masses, the result of powerful lateral thrust which has caused the rocks to arch and buckle and even to break and slide over each other for long distances. The cause of such lateral compression is still one of the great unsolved problems of geology. The intensity and magnitude of these forces may be judged when it is known that in many areas the rocks have shoved over and past one another distances of several miles. The pressure and accompanying heat often profoundly alter or metamorphose the rocks, with the development of new minerals, the formation of cleavage, and the destruction of bedding and fossils, until in many regions it is impossible to determine whether the rocks were originally igneous or sedimentary. Quartzite, gneiss, schist, slate, and marble are the usual resulting products. See ROCK CLEAVAGE; FOLDS; FAULT; METAMORPHISM; METAMORPHIC ROCKS; MOUNTAINS; STRUCTURAL GEOLOGY; etc.

Earthquakes.— The processes outlined above may usually be considered as the resultant of a very great number of successive small but sometimes sudden movements. Along any line of weakness the stress gradually accumulates until suddenly the rock yields by bending or breaking, causing a tremor known as an earthquake. The stress is relieved and years may intervene before there is sufficient accumulation of forces to cause another movement in the same place. Considered broadly, earthquakes are geological results rather than causes, but they in turn produce certain minor effects of geologic importance. They are a frequent cause of landslides and avalanches. Underground water circulation is often disturbed by the cracking of the rock, so that springs and wells go dry and new springs are formed. Along the fracture or faults that caused the shock there is frequent shifting of the walls, one side not uncommonly being raised so that a low cliff or scarp is formed, which may obstruct rivers and form lakes or falls. Permanent changes of level frequently accompany earthquakes. In Alaska in 1899 portions of the coast were uplifted 47 feet. In thickly settled regions destruction to life and property is a notable result. See EARTHQUAKE.

Volcanism.— Volcanism includes all those phenomena dependent on the movement of molten rock (magma) within the earth or on its surface. The cause of volcanism is another great geologic problem which is far from being settled. One school believes that the lava is a still uncooled residue from a once molten earth. Another believes lavas form from the melting of rocks in the earth's crust due to relief of pressure caused by the arching up of folds, to heat generated by crushing and shearing of rock masses, or to still other causes. From its deep seated source, this fluid rock works its way toward the surface, sometimes along cracks, sometimes by melting its way through the rocks. That which reaches the surface may pour out quietly or burst forth with explosive violence.

Volcanic products are of three types, gases, liquids and solids. Of the gases, steam and carbon dioxide are by far the most abundant. Sulphur gases, chlorine, hydrochloric acid, and a number of rarer substances are also usually present. These may be derived in part from the sediments traversed but are largely original in the magma. Highly heated fluid rock called lava is the most abundant product. Such rock, when it cools slowly at great depth and retains its water content, is usually coarsely crystalline and forms granite, gabbro, etc. When forced out at the surface, where it cools quickly and loses its moisture, it forms very fine crystals or becomes glassy, in which case we have basalt, trap, rhyolite, obsidian, etc. (See BASALT; GRANITE; IGNEOUS ROCKS; TRAP; etc.). During explosive eruptions much solid material is blown out of the crater. If very fine, this is known as ash; if slightly coarser, lapilli; and these when consolidated form volcanic tuff: Still coarser material is known as volcanic breccia or agglomerate. Lava hurled into the air in a semifluid form and rapildy rotated takes on a circular shape forming volcanic bombs. Such material if highly porous is called pumice. The solid volcanic ejecta are known as pyroclastics.

Extrusive Phenomena.— Material which actually reaches the earth's surface is said to be extrusive. Among the most important extrusive phenomena are cones, craters, lava flows and ash beds. The cone is the hill built up around the volcanic vent, and where formed wholly of lava it is low and flat, but a cinder cone of solid ejecta is capable of standing in steeper slopes. Composites of both types are most common. Most large cones show numerous secondary or parasitic cones built over subordinate vents. The crater is the hollow in the cone from which the lava issues. In the great Hawaiian volcanoes the craters are several miles across and constitute veritable lakes of hot liquid rock. After volcanoes become extinct, the craters may be occupied by lakes, as in Crater Lake, National Park, Oregon. Where the lava is stiff and viscuous it may flow only a short distance, but with very fluid lavas the flows may be many miles in extent. In the Columbia Plateau of Central Washington one such flow followed another, with thin beds of sand and gravel between, to a total thickness of from two to four thousand feet. The surfaces of lava flows are usually cindery or scoriaceous, and full of blow holes. As the flows move forward they often pick up waterworn bowlders of rock, fragments of trees, and other debris. They may later be buried under hundreds of feet of sediments, but the scoriaceous surfaces, steam cavities, and included bowlders serve to prove their surface origin. Volcanic ash is often very fine and may be wind drifted for miles. In Nebraska, many miles from the nearest possible volcanic source, are beds of such ash varying from a few inches to several feet in thickness now buried under other rock.

Intrusive Phenomena.— Fluid rock which forces its way into and through the surrounding rocks but is not poured out at the surface is said to be intrusive. It occurs in a variety of forms the most important of which are dikes, sills, laccoliths, and batholiths. Fluid rock filling fractures in other rocks constitutes dikes, which may occupy any position whatever, but are usually more nearly vertical than horizontal. Thin sheets of lava insinuated between beds along bedding planes are known as sills. They may be either horizontal or vertical, dependent on the position of the beds between which they are intruded. Bodies similar to sills but thick enough to arch up the overlying beds into domes are called laccoliths. Very large irregular-shaped bodies which melt their way across the enclosing rocks at any angle are known as batholiths and may be many miles in extent. Pipes and plugs are nearly circular small bodies, and stocks and bosses are essentially small batholiths.

Contact Metamorphism.—At the contact between igneous rocks and the rocks into which they are intruded, particularly if the igneous bodies are very large and at very high temperatures, there is usually profound alteration or metamorphism of the wall rocks. New minerals are formed, usually silicates, since these are best adapted to conditions of high temperature and great pressure. Garnets are commonly developed in limestones and aluminum silicates in shales. Quartzites suffer less change. See ANDALUSITE; GARNET; MAGNETITE; METAMORPHISM; etc.

Volcanism and Ore Deposits.— With few exceptions the great ore deposits of the world are connected with igneous activity. In a few cases, as in certain magnetite deposits, and in the case of the Sudbury nickel district, the ores have probably actually solidified from a fluid state with the enclosing igneous rock. In other cases, as at the Clifton-Morenci copper camp in Arizona, bodies of igneous rock have metamorphosed the adjacent limestones into a great mass of garnet rock and copper ore, the ore probably coming from the hot igneous rock. In still other cases the igneous rocks upon cooling have given off hot magmatic waters with ores in solution. These have passed upward into cracks in the overlying rocks and as they cooled have deposited their metals. This is now believed to be the origin of a very large number of the ore deposits. In still other cases the igneous rock has heated the ordinary ground water, thus giving it a greater power of dissolving mineral matter and rendering it more efficient in the gathering together of ore deposits. See DIKE; ECONOMIC GEOLOGY; METAMORPHISM; MAGMATIC SEGREGATION; ORE DEPOSITS; VOLCANOES; etc.

STRUCTURAL GEOLOGY (GEOTECTONICS).

This branch of geology outlines the way in which earth materials are put together. Certain structural features imparted to the rocks at the time they are formed are called original; others imposed on the rocks by deformation at a subsequent period are called secondary or induced structures.

Original Structures.— Practically all sedimentary rock shows a tendency toward arrangement in parallel beds, due primarily to the sorting power of wind or moving water. Just so long as the water of a lake, for example, is strongly agitated only coarse material settles out. This makes one bed. When the water becomes quiet, the fine material settles out, and another layer is formed, differing slightly from the first. On a sea bottom where clay has been deposited, uplift may bring the area closer to shore, and sand beds may follow, or sinking may cause the reverse change. Some layers may be many feet thick, others thin as a sheet of paper. But the final result is that most sediments are layered or stratified. The structure is highly important, for it aids in weathering, helps to control the shapes of cliffs, hills, and various land forms, modifies the circulation of ground water and aids in quarrying. See STRATIFICATION.

In sand dunes, sand bars, alluvial fans, deltas, spits and beaches where there are currents, layers of sand or mud are often laid down on sloping instead of horizontal surfaces. This may produce for short distances inclined layering known as false bedding or cross bedding which in small exposures may be mistaken for true bedding, and lead to the incorrect idea that the beds have been tilted, when as a matter of fact they have been formed in this inclined position.

Ripple marks may be defined as rhythmic undulations made on the surface of unconsolidated sediments. They may be formed by running water on the surface of sand bars. Almost everyone has noticed the little closely spaced ridges occurring after a downpour along the bottoms of channels that were recently full of running water. Wind also makes tiny ripples on sand dunes. The constant back and forth movement of waves makes similar small parallel ridges of even more regular pattern on the sandy bottom of shallow bodies of water. If these ridges become buried before they are destroyed and the material hardens, the real ripple may be preserved with its duplicate in reversed form as a cast on the lower surface of the overlying bed. Practiced observers can frequently tell the ripple from its reversed cast and are thus enabled to tell whether the beds are right side up, even in regions where there has been intense folding. Ripples are rarely found in deep sea sediments as the water is too deep for waves to disturb the bottom. See RIPPLE MARKS.

Mud flats that are long exposed to the sun's rays crack to considerable depth, the crack being widest at the top and pinching out below. If sand drifts over this surface and fills these little fissures, the beds may subsequently solidify and the filled crack be preserved in the rock. As the crack is widest at the top, this structure too can be used to tell whether or not the bed is right side up. Sun cracks are found in terrestrial sediments, but obviously not in marine beds.

Slight showers sometimes leave rain drop imprints on mud surfaces. These may likewise be buried, harden, and be preserved. Little rill marks, channels made by running water, may be preserved in a similar manner, as may also foot prints left by animals in the mud. These are all characteristic of terrestrial rather than marine sediments and, as in the case of ripples and sun cracks may be used to tell top from bottom of beds.

A layer of sediment may be formed beneath the sea, the region may then emerge and be carved into hills and valleys. Another submergence may cause continued sedimentation, later beds being laid down on top of the old erosion surface. Such an erosional break in the continuity of deposition is said to be an unconformity, and the upper beds rest unconformably on the lower. At the time of emergence there may be folding, the folds being planed off by the subsequent erosion. The later series of beds may then be laid horizontally across the truncated upturned edges of the older beds. This is an angular unconformity, and the beds are said to be discordant. A knowledge of unconformity is highly important in studying the geology of a given region. See UNCONFORMITY.

Secondary or Induced Structures.—Joints are fractures which traverse rock masses. Sometimes they occur in definitely spaced sets, in which case they comprise a joint system. Two or more systems may occur in the same region dividing the rock into regular blocks. Columnar jointing in lavas is supposed to be due to shrinkage from cooling. (See GIANT'S CAUSEWAY). Other joints are the result of internal deformation that bends and cracks the rock. Still other joints may be due to shrinkage of sediments from loss of water on drying. Jointing modifies ground water circulation, favors the deposition of mineral matter as veins, and aids in quarrying. See JOINTS.

Faults are fractures along which there has been slipping of one of the rock walls past the other. In extreme cases one wall has dropped several thousand feet with respect to the adjacent side, resulting in a cliff known as a fault scarp. Erosion, however, soon removes such a cliff and the majority of faults, unless very recent, have no scarps. Sometimes the plane of breaking is nearly horizontal, and lower and older beds have been thrust far out over younger formations. Such thrust faults are most common in closely folded mountain regions, and are sometimes known with movements as great as fifteen miles or more. Mineral veins or seams of coal may be faulted off and portions of them never discovered. The entire subject of faulting is one of great interest in mining. See FAULT.

In many regions, particularly in mountainous ones, compression has caused the buckling of the rocks into great folds. Upward arches are known as anticlines, trough-like folds as synclines. Folds vary from a few inches across to many miles, and from the gentlest swells to structures in which the beds are vertical or even overturned. An anticline when first formed constitutes an elevation or mountain which, however, may soon be completely removed by erosion, though the structure is still called a fold. After peneplanation the beds on either side will be exposed in long parallel lines, and if there are many parallel folds the same formation may outcrop repeatedly. See FOLDS.

In intensely folded regions where rocks have undergone great pressure, new minerals usually grow with their longer dimension at right angles to the pressure, as that is the easiest way for them to develop. As a result the rock manifests a tendency to split more easily parallel to the long dimensions of the minerals, just as wood splits parallel to the grain. Such a tendency is called cleavage and is best shown in schists and slates. See ROCK CLEAVAGE.

STRATIGRAPHY.

Correlation.— Practically all the success that has been attained in working out earth history in detail has depended on the ability to correlate beds of rock in widely separated areas. Such stratigraphic correlation rests on two highly important principles. The first of these is that in regions where the beds preserve their normal order, undisturbed by folding, the older beds are below and the younger above. The second is the principle of progressive evolution; that is, in the earliest geologic periods simple forms of life predominated, but as time went on old forms became extinct and new forms evolved, so that of two assemblages of fossils from rocks of different ages certain forms may be common to both, certain forms found in the older will be absent from the younger, and certain forms found in the younger will not be present in the older.

Admitting these two principles, let it be assumed that in an unfolded region three formations A, B and C rest one on the other, A being the lowest (oldest) and C the highest (youngest). In a region several miles away three formations are also found, the lowest bed of which has the same fossils as B, the middle stratum the fossils of C, while a still higher formation has fossils not found in the first region. This latter assemblage may be called D. It is at once obvious that D is younger than any bed in the first region. This illustrates in its simplest form the principle of stratigraphic correlation by fossils. If in a distant region which is much folded, rocks with the same assemblages of fossils are found standing vertical, it thus becomes possible to determine which is the older. See Fossils; Palæontology; Palæobotany.

Divisions of Geologic Time.—At various times in the earth's history there have been great though slow diastrophic revolutions, resulting in the formation of mountain ranges, the emergence of vast areas from the sea, and notable climatic changes. These profound modifications of living conditions have made equally profound changes in life forms, bringing about the extinction of many unfit genera and the development of new genera better suited to the changed conditions. These more pronounced revolutions in geography and life have been used as the dividing points between the larger time units in geology, known as eras. Less notable changes of similar nature have given rise to periods. Divisions which suit the facts in one locality may not apply elsewhere, and with increased information there has been a constant growth and modification of time nomenclature. The accompanying table of time units is the one used by the United States Geological Survey. With minor modifications the scheme is accepted over practically all of the civilized world. A few of the names are remnants of the older ideas. Tertiary and Quaternary remain from a day when it was believed all geologic time was divisible into four units, Primary, Secondary, Tertiary and Quaternary. Carboniferous (coal bearing) and Cretaceous (chalk bearing) are remnants of the idea that rocks could be correlated on the basis of similar composition. It is now known, however, that rocks of identical character may have formed during many widely separated periods.

Era	Period	Epoch
Cenozoic	Quaternary	Recent, Pleistocene
	Tertiary	Pliocene, Miocene, Oligocene, Eocene
Mesozoic	Cretaceous, Jurassic, Triassic	
Paleozoic	Carboniferous	Permian, Pennsylvanian, Mississippian
	Devonian, Silurian, Ordovician, Cambrian	
Proterozoic	Algonkian	Keweenawan, Huronian
	Archean	Laurentian, Keewatin

The tendency now is to derive names from regions where certain units are well exposed. Devonian from Devonshire, Jurassic, from the Jura Mountains and Huronian from Lake Huron are examples.

The rocks of a certain period are spoken of as a system, for example, the Cambrian system, the Cretaceous system. The smallest units to be given separate rank on a map are subdivisions of the system called formations, which usually, though not always, consist practically of one kind of rock, as the Saint Peter sandstone formation, the Madison limestone formation, and which are usually given the name of a locality where they outcrop prominently. The major facts of history for each period will be given in a separate article on that period, these facts including the thickness and nature of the sediments, whether terrestrial or marine, chemical or mechanical; the extent and importance of unconformities; geography of the period, whether land or sea, plains or mountains; climate, folding and faulting, volcanism, glaciation and a careful study of the life record. See Cenozoic Era; Devonian; etc.

Age of the Earth.— Much interest has always attached to the determination of the length of geologic time. Physicists computing the length of time which it has taken the earth to cool at the present rate from the highly heated condition assumed under the nebular hypothesis arrive at a figure of about 20,000,000 years. Geologists have approached the problem in other ways. One of these is the computation of the length of time it might take to accumulate the known thickness of sedimentary rocks. By careful studies it is possible to get an average figure for the rate of accumulation of sediments in the ocean at the present time. It is also possible to determine the average thickness of sedimentary rocks in many regions. Assuming the present rate of accumulation to have been constant throughout geologic time, the required time to accumulate the known thickness of rocks is about 100,000,000 years.

Still another method of attack is based on the salinity of the ocean. All rivers carry common salt to the ocean, and it is believed that all the salt of the sea has been so derived. The area, average depth, and percentage of salinity of the ocean being known, its volume can be computed and the total number of tons of contained salt be determined. The composition and amount of water delivered to the sea each year by all the larger rivers of the world is known, so the total amount of salt added to the ocean each year is determinable. Dividing the total salt in the ocean by the amount added each year, gives 70,000,000 years as the time it has taken to reach the present degree of salinity. This computation is based on the two assumptions that little salt is ever removed from the ocean, and that rivers have always carried salt in about the present amount. These assumptions are not strictly true and necessary corrections have been attempted. Such computations involve so much that is uncertain that they are to be accepted with the utmost caution. They establish, however, beyond much doubt that geologic time is enormously long. All geologists agree that it is to be measured in millions of years, rather than in hundreds of thousands.

Bibliography.—*American Geologist* (Minneapolis 1888–1905); *American Journal of Science* (New Haven 1818–date); Arrhenius, S., 'Lehrbuch der Kosmischen Physik' (Leipzig 1903); Ball, R. S., 'The Earth's Beginnings' (London 1901); Bischof, Gustav, 'Chemical and Physical Geology' (ib. 1854–59); Blackwelder, Eliot, 'Handbuch der Regionalen Geologie, United States of North America' (Heidelberg 1910); Blackwelder, Eliot, and Barrows, H. H., 'Elements of Geology' (New York 1911); *Bulletin* of the Geological Society of America (Rochester 1890–date); Chamberlain, T. C., and Salisbury, R. D., 'Geology' (3 vols., New York 1905–06); Cleland, H. F., 'Geology, Physical and Historical' (ib. 1916); Cole, G. A., 'Aids in Practical Geology' (6th ed., London 1909); Credner, H., 'Element der Geologie' (Leipzig 1897); Dana, J. D., 'Manual of Geology' (4th ed., New York 1895); Davis, W. M., 'Geographical Essays' (New York 1909); De Lapparent, A., 'Traité de geologie' (5th ed., Paris 1906); De Martonne, E., 'Geographie physique' (ib. 1909); Elsden, J. V., 'Principles of Chemical Geology' (London 1910); Farrell, J. H., 'Practical Field Geology' (New York 1912); Geikie, Sir Archibald, 'Outlines of Field Geology' (5th ed., London 1900); id., 'Textbook of Geology' (4th ed., ib. 1905); id., 'The Founders of Geology' (2d ed., ib. 1906); id., 'The Scenery of Scotland' (3d ed., ib. 1901); Geikie, J., 'Structural and Field Geology' (3d ed., New York 1912); *Geological Magazine* (London 1864–date); Gilbert, G. K., and Brigham, A. P., 'Introduction to Physical Geography' (New York 1908); Grabau, A. W., 'Principles of Stratigraphy' (New York 1913); Grubenmann, U., 'Die Kristallinen Schiefer' (Berlin 1910); Haug, E., 'Traité de geologie' (Paris 1907); Hayes, C. W., 'Handbook for Field Geologists' (New York 1909); Hilgard, E. W., 'Soils' (New York 1911); Hobbs, W. H., 'Earth Features and Their Meaning' (ib. 1912); Joly, J., 'Radioactivity and Geology' (New York 1909); *Journal of Geology* (Chicago 1893–date); Keilhack, K., 'Lehrbuch der Grundwasser und Quellenkunde' (Berlin 1912); Kemp, J., 'A Handbook of Rocks' (5th ed., New York 1911); Lahee, F. H., 'Field Geology' (ib. 1916); Lake, P., and Rastall, R. H., 'A Text Book of Geology' (London 1910); Le Conte, J., 'Elements of Geology' (5th ed., New York 1903); Leith, C. K., 'Structural Geology' (ib. 1913); Leith, C. K., and Mead, W. J., 'Metamorphic Geology' (ib. 1915); Leyell, Sir Charles, 'Principles of Geology' (10th ed., London 1867); Merrill, G. P., 'Contributions to the History of American Geology' (Washington 1906); Merrill, G. P., 'Rocks, Rock-Weathering, and Soils' (New York 1897); *National Geographic Magazine* (Washington 1888–date); 'Neues Jahrbuch für Geologie, Mineralogie, und Paläontologie' (Stuttgart, 1881–date); Norton, W. H., 'The Elements of Geology' (New York 1905); Paulcke, W., 'Das Experiment in der Geologie' (Berlin 1912); Pirrson, L. V., and Schuchert, C., 'A Text Book of Geology' (New York 1915); Prestwich, J., 'Geology, Chemical, Physical and Stratigraphical' (Oxford 1886–88); *Quarterly Journal of the Geological Society* (London 1845–date); Reade, T. M., 'Evolution of Earth Structure' (New York 1903); Rice, W. N., and others, 'Problems of American Geology' (New Haven 1915); Richthofen, F., von, 'Führer für Forschungsreisende' (1886); Ries, H., and Watson, T. L., 'Engineering Geology' (2d ed., New York 1915); Russell, I. C., 'North America' (ib. 1904); Schwarz, E. H. L., 'Causal Geology' (London 1910); Scott, W. B., 'An Introduction to Geology' (2d ed., New York 1909); Shaler, N. S., 'The Story of Our Continent' (Boston 1892); Suess, E., 'Das Antlitz des Erde' (translated into the French 'La face de la Terre' — and the English, 'The Face of the Earth' Prague 1883–88); Tarr, R. S., 'New Physical Geography' (New York 1908); Tarr, R. S., and Martin, L., 'Alaskan Glacier Studies' (Washington 1914); Walther, J., 'Das Gesetz der Wüstenbildung' (2d ed., Leipzig 1912); Wright, G. F., 'The Ice Age in North America' (New York 1890); and 'Man and the Glacial Period'; Wright, W. B., 'The Quaternary Ice Age'; *Zeitschrift für Gletscherkunde* (Vienna 1907–date); *Zeitschrift für praktische Geologie* (Berlin 1893–date).

For special bibliographies, see ECONOMIC GEOLOGY; ROCKS; MINERALOGY; PHYSIOGRAPHY; GLACIERS; VOLCANOES; PALEONTOLOGY; FOSSILS; etc.

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GEOMANCY, jē'ō-măn-sĭ (Greek, *gē*, the earth, and *manteia*, divination), a kind of divination formerly practised. Sparry, in his translation of Cattan's 'Geomancie' (written about the middle of the 16th century, and translated in 1591), says: "Geomancie is a science and art which consisteth of points, prickes, and lines made instead of the foure elements, and of the starres and planets of heaven. . . . And this art may be made on the earth or on white paper, or uppon any other thing whereon it may commodiously be done, so that the prickes and lines may be knowen." See DIVINATION; FUNG-SHUI.

GEOMETRIC SERIES. See SERIES.

GEOMETRICAL MEAN of two numbers is that number the square of which is equal to the product of the two numbers; thus, the geometrical mean of 9 and 16 is 12, for $9 \times 16 = 144 = 12^2$. Hence the geometrical mean of two numbers is found by multiplying the two numbers together and extracting the square root of the product.

GEOMETRICAL OPTICS. Fundamental Laws.— The fundamental characteristics of the mode of propagation of light in so-called isotropic media are usually explained in terms of three propositions, namely, (1) the law of the rectilinear propagation of light, (2) the mutual independence of the "rays" which constitute a beam of light, and (3) the abrupt changes in the directions of the rays of light produced by reflection or refraction at a surface of separation between two media of different optical densities like air and glass. These laws (which are to be regarded as only partially exact) are concerned essentially with the directions which the light pursues under given conditions and are therefore purely geometrical; and hence the science which is based upon them and which seeks by their aid to explain the phenomena of light, either as they occur in nature or as they are produced by the agency of optical instruments, is called Geometrical Optics.

The fact that light traverses a homogeneous medium in straight lines is confidently assumed in matters of everyday life, although it is known to be not absolutely and unexceptionally true. When an opaque body is interposed anywhere in the straight line joining a luminous object with the eye, the object is thereby rendered invisible, and the familiar phenomena of shadows find their simplest explanation in this law. The principle of the mutual independence of the rays of light assumes that each ray in a beam of light is somehow separate and distinct from its fellows and has therefore a certain physical existence, although it is impossible to isolate a single ray of light. Actually, we have always to deal with a bundle of rays, which may be *homocentric* or *monocentric* (in case all the rays of the bundle meet in one point), but which, in general, is *astigmatic* (which means literally «without focus»). The laws of the reflection and refraction of light remain to be stated.

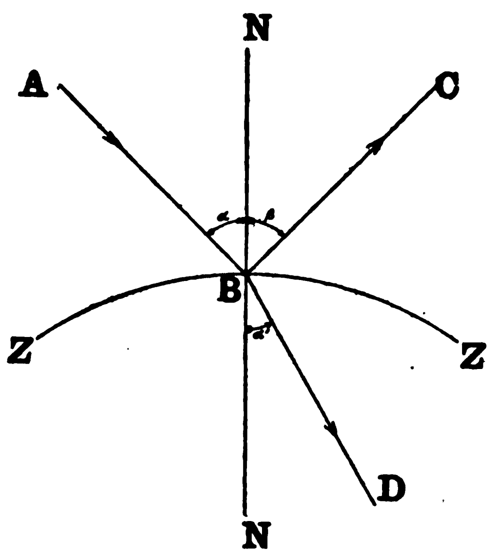


FIG. 1.

When light is incident on a smooth, polished surface separating two isotropic media of different optical densities, part of the light will be reflected back into the first medium and part will be refracted into the second medium, according to the following laws:

(1) Both the reflected and refracted rays lie in the plane of incidence (which is the plane determined by the incident ray and the normal to the boundary-surface at the point of incidence: see Fig. 1).

(2) The angles of incidence (α) and reflection (β) are equal in magnitude but opposite in sign ($\beta = -\alpha$); that is, the incident and reflected rays lie at equal angular distances from the normal on opposite sides thereof (Law of Reflection).

(3) The sines of the angles of incidence (α) and refraction (α') are in a constant ratio, which is equal to the ratio of the velocities of light (v, v') in the two media; that is,

$$\sin\alpha : \sin\alpha' = v : v' = \text{constant}.$$

The value of this constant depends only on the nature of the two media and the color of the light or its wave-length *in vacuo*. (Law of Refraction).

By the angles of incidence, reflection and refraction are meant here the acute angles between the incidence-normal and the incident, reflected and refracted rays, respectively.

This constant ratio of the velocities of propagation of monochromatic light in two different media is called the *relative index of refraction* of the two media. The *absolute index of refraction* of an optical medium for a given kind of light is defined to be the ratio of the velocity of light *in vacuo* to its velocity in the medium in question. If the absolute indices of refraction of two media are denoted by n and n' then $v : v' = n' : n$, and, accordingly, the law of refraction may be written in the following invariant form:

$$n \cdot \sin\alpha = n' \cdot \sin\alpha'.$$

Since the velocity of light in a medium is different for light of different colors, the index of refraction of a medium depends on the color of the light, and hence in speaking of the index of refraction of a substance it is necessary to specify the quality of the homogeneous or monochromatic light to which this number refers. Usually its value is found to be greater for yellow light than for red and greater for blue than for yellow; so that, in general (although there are some curious exceptions), light is found to be more and more «refrangible» as we proceed from the red to the violet end of the normal spectrum. When we say, for example, that the index of refraction of water is 1.334 or that of alcohol is 1.363, generally it is tacitly assumed that the value applies to rays of light corresponding to the Fraunhofer D-line in the light yellow part of the solar spectrum, which is characteristic of the light emitted by incandescent sodium vapor. Thus,

$$n_D = \frac{\text{velocity of yellow light } \textit{in vacuo}}{\text{velocity of yellow light in the given medium}}$$

The indices of refraction of the more useful kinds of glass used for optical prisms and lenses vary from about $n_D = 1.49$ to $n_D = 1.65$. The index of refraction of air at 0°C. and under a pressure of 76 cm. of mercury is $n_D = 1.0002429$, which is so nearly equal to unity that it is usually so considered.

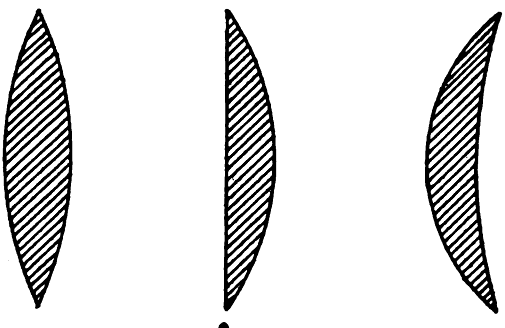
The color dispersion of an optical medium is estimated by its *dispersive power*, which is defined by the following ratio:

$$\text{Dispersive power} = \frac{n_F - n_C}{n_D - 1}$$

where the symbols n_C, n_D, n_F, denote the magnitudes of the indices of refraction for light corresponding to the Fraunhofer lines C (red), D (yellow), F (blue), respectively. The reciprocal of the dispersive power of the more important varieties of glass used in the manufacture of optical instruments varies between the limits 70 and 30.

Optical Images.— Generally, when an object is viewed, directly or indirectly, not all or even most of the rays which are emitted are utilized for the purpose of vision. In fact, it is usual to interpose in front of the luminous object an opaque screen with a suitable opening in it for the express purpose of intercepting the needless or undesirable rays and permitting the others, called the *effective rays,* to pass unhampered through the opening. This is admirably exemplified by the iris opening in the human eye which enables the observer to utilize only those rays which are best adapted to the organ of vision, so that from each point of the object in the field of view there comes into the eye a bundle of effective rays whose aperture is determined by the dimensions of the pupil. The organ of vision is subject to optical illusions in regard to the external world, due to various causes, among others to the fact that the eye judges the object to be at the place whence the rays emanate just before entering the eye, which may not correspond to the place where the object actually is. Thus, for example, if the bundle of rays proceeding originally from a luminous point of the object has been modified by reflection or refraction before entering the eye, the object itself will not be visible, and at best the eye can perceive only a so-called *image* of the object, which in general will be blurred and distorted and situated differently from the object as to both distance and direction. In the singular and very special case when the effective rays after emerging from the optical system of isotropic media, which are here supposed to be interposed between the object and the eye, all meet again in one point, there will be formed at this point an *ideal optical image* of the luminous object-point. And even when the image is not absolutely ideal, it may be so nearly perfect that the limited resolving power of the human eye is not able to discern its faults, so that then the image is practically ideal.

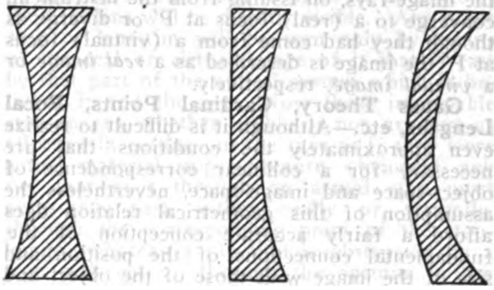
Nearly all optical instruments are contrivances for utilizing the phenomena of light in order to reproduce as distinctly and faithfully as possible images of luminous objects. Such instruments (e.g., microscope, telescope, photographic lens, etc.) are usually composed of a single lens or combination of lenses. The word *lens* is used in optics to denote a portion of a



a b c

FIG. 2.

transparent substance, usually isotropic and most often made of glass, comprised between two smooth polished faces, one of which may be plane. (If both faces are plane, it is not a lens but a *prism*—or a slab, in case the two plane faces are parallel). The faces of the lens are generally, but not necessarily, spherical in form. The *optical axis* of a lens is a



a b c

FIG. 3.

straight line which is normal to both faces, and consequently a ray whose path lies along the axis (the axial ray) will pass through the lens without being deflected from this line. A lens is said to be *convex* or *concave* according as it is thicker or thinner, respectively, in the middle along the axis than out toward the edges. A convex lens may be double convex (Fig. 2, *a*), plano-convex (Fig. 2, *b*) or a convex meniscus (Fig. 2, *c*); similarly, a concave lens may be double concave (Fig. 3, *a*), plano-concave (Fig. 3, *b*) or a concave meniscus (Fig. 3, *c*). A convex glass lens of moderate thickness, surrounded by air, will be found to converge a beam of parallel rays of sunlight to a focus on the far side of the lens; and hence it is said to be a *convergent* or *positive lens.* On the other hand, a concave lens under the same circumstances will render a beam of sunlight divergent, and hence it is called a *divergent* or *negative lens.*

The lenses in an optical instrument are almost invariably disposed so that the centres of the spherical refracting surfaces lie all on one straight line, which is an axis of symmetry (*optical axis*). The instrument is said to divide the surrounding region into two parts known as *object-space* and *image-space;* which, however, are not to be regarded as separate and distinct parts of space, but rather as names to be applied, to different aspects of the same space; whereby any point or straight line may be considered as belonging equally to either region depending merely on the point of view. The effective rays before they enter the instrument are called *object-rays,* since they have their origins in the luminous object; whereas the emergent rays which go to form the more or less imperfect image are called *image-rays.*

If the problem is restricted (for example, by a suitable arrangement of "stops" with very narrow openings) to such rays as are never at any stage in their passage through the symmetrical optical instrument very far from the optical axis (so-called *paraxial rays*), it may be shown that under these circumstances (assuming also that we have to deal only with monochromatic light) there will be ultimately strict collinear correspondence between object-space and image-space; so that the bundle of image-rays corresponding to a homocentric bundle of object-rays will also be homocentric, and accordingly every point P of the object will be reproduced by an ideal image P′ which is said to be "conjugate" to P. According as the image-rays, on issuing from the instrument, converge to a (real) focus at P′ or diverge as though they had come from a (virtual) focus at P′ the image is described as a *real image* or a *virtual image*, respectively.

Gauss Theory, Cardinal Points, Focal Lengths, etc.—Although it is difficult to realize even approximately the conditions that are necessary for a collinear correspondence of object-space and image-space, nevertheless the assumption of this geometrical relation does afford a fairly accurate conception of the fundamental connections of the position and size of the image with those of the object and enables us to form an idea of the general and salient characteristics of the imagery. A general method of treating the problem of the imagery produced by the refraction of paraxial rays through a centered system of lenses was published by C. F. Gauss in his famous *Dioptrische Untersuchungen* in 1841. According to this theory the action of such a system is completely determined by the positions on the axis of four *cardinal points*, namely, the two *focal points* F and F′ (Fig. 4) and the two *principal points* H and H′. These points must now be defined.

In every centered system of spherical refracting surfaces there are two (and only two) transversal planes at right angles to the optical axis which are characterized by the following properties:

A bundle of paraxial object-rays which all meet in a point in one of these planes (*the primary focal plane*) will emerge from the system as a cylindrical bundle of parallel image-rays; and, similarly, a cylindrical bundle of parallel object-rays will emerge from the system as a bundle of image-rays which all meet in a point in the other one of these planes (*the secondary focal plane*). The points where the focal planes are pierced by the optical axis are the *primary* and *secondary focal* points F and F′ above mentioned.

Moreover, in every symmetrical system of lenses there is one (and only one) pair of *conjugate planes* perpendicular to the axis which are distinguished by the property that in these planes object and image are congruent; and, therefore, any straight line drawn parallel to the axis of symmetry will intersect these planes in a pair of conjugate points. These are the so-called principal planes, one belonging to the object-space (*the primary principal plane*) and the other belonging to the image-space (*the secondary principal plane*). The *primary and secondary principal points* H, H′ are the axial points of the principal planes.

Construction of the image.—Provided the positions of the cardinal points F, F′ and H, H′ are given, the image-point Q′ conjugate to an extra-axial object-point Q may be found by the following geometrical construction (Fig. 4).

Through Q draw the straight line QV′ parallel to the axis meeting the secondary principal plane in V′, and also the straight line QF meeting the primary principal plane in W. The required point Q′ will be at the intersection of the straight line V′F′ with the straight line WQ′ drawn parallel to the axis. The feet of the perpendiculars let fall from Q, Q′ on to the axis will locate also a pair of conjugate axial points M, M′, and M′Q′ will be the image of MQ.

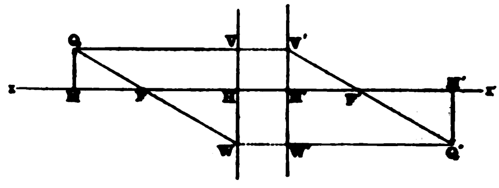


FIG. 4.

Thus, point by point, the *image-relief* corresponding to a given 3-dimensional object may be constructed; and in this image-relief object-planes perpendicular to the axis will be reproduced by similar plane figures placed at right angles to the axis, but in general the *magnification-ratio* (M′Q′:MQ) will be different for different pairs of conjugate transversal planes, assuming all possible values positive and negative depending on the place of the object.

However, in the special case when the object-point is infinitely far away, the construction as given above fails. Suppose, for example, that the object is a distant star seen by the naked eye in the direction of the straight line FI (Fig. 5) which makes an angle $\omega = \angle$ HFW

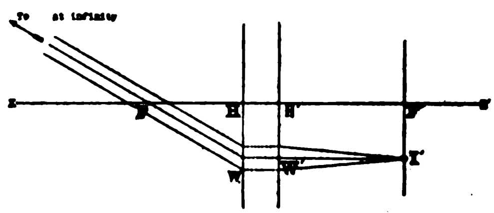


FIG. 5.

with the optical axis of the instrument. Its image will be formed at the point I′ (conjugate to the infinitely distant object-point I) where the straight line WI′ drawn parallel to the axis meets the secondary focal plane.

Focal Lengths.—The focal lengths, denoted by f and f', are defined to be the abscissae of the principal points with respect to the corresponding focal points as origins; thus, $f =$ FH, $f' =$ F′H′; and if the indices of refraction of the object-space and image-space are denoted by n and n', respectively, the theory shows that

$$\frac{f}{f'} = -\frac{n}{n'}.$$

This fundamental relation may be expressed by saying that the focal lengths of a centered system of spherical refracting surfaces are proportional to the indices of refraction of the first and last media, and are opposite in sign; except in the single case when the optical system includes an odd number of reflecting surfaces, under which circumstances the focal lengths have the same sign $\left(\frac{f}{f'} = +\frac{n}{n'}\right)$.

In particular, when the media of object-space and image-space are identical ($n' = n$), the focal lengths are equal in magnitude ($f' = -f$, or, in case of an odd number of reflecting surfaces, $f' = f$).

Image-Equations.— If the co-ordinates of the pair of conjugate points Q, Q′ (Fig. 4), referred to two systems of rectangular axes with their origins at the principal points H, H′ are denoted by (u, y) and (u', y'); that is, if $u =$ HM, $y =$ MQ and $u' =$ H′M′, $y' =$ M′Q′, the following relations may be derived immediately from the figure:

$$\frac{f}{u} + \frac{f'}{u'} + 1 = 0 \text{ (abscissa-equation),}$$

$$\frac{y'}{y} = \frac{f}{f+u} = \frac{f' + u'}{f'} = -\frac{f.\, u'}{f'.\, u}$$

(magnification-formula).

These are the so-called *image-equations* referred to the principal points. If we introduce the symbols

$$U = \frac{n}{u}, U' = \frac{n'}{u'}, F = \frac{n}{f} = -\frac{n'}{f'},$$

where n, n' denote the indices of refraction of the media of the object-space and image-space, these equations may also be put in the following simple and convenient form:

$$U' = U + F, \frac{y'}{y} = \frac{U}{U'}.$$

The magnitude denoted by F is called *the refracting power* of the optical system, and the symbols U, U' denote the so-called *reduced vergences* of the object-rays and image-rays. If the linear magnitudes u, u', f and f' are expressed in meters, the reciprocal reduced magnitudes U, U' and F will be expressed in terms of a unit called a *dioptry* (sometimes written *diopter* or *dioptre*), which is defined to be the curvature of a sphere of radius one meter. This unit which was introduced into lens-optics by the opticians and spectacle-makers has been adopted into optical science.

Stops.— But the mere geometrical assumption of a point-to-point correspondence between object-space and image-space by means of rectilinear rays (even were it realizable) is not by itself sufficient to explain the *modus operandi* of an actual optical instrument, because it leaves entirely out of account two fundamental conditions which are essential to all mechanical contrivances for the production of an optical image; namely, first, the fact (already alluded to) that the bundles of effective rays are necessarily limited by the transversal dimensions of the instrument (the diameters of the lens-fastenings, artificial diaphragms or «stops» and walls of the tube); and, second, the fact that the image, instead of being left floating in the air, is cast on a screen or surface of some kind, for example, the ground-glass plate of a photographic camera, or in the last analysis the surface of the retina of the observer's eye. Obviously, it will only be under very exceptional circumstances that this receiving surface will contain all the image-points that are conjugate to the points of the object-relief; so that even though the imagery were ideal in the sense of collinear correspondence between object-space and image-space, some parts of the image projected on the screen will be more or less blurred and indistinct due to this method of representation.

In addition to the circular fastenings of the lenses, the system may also be provided with artificial diaphragms or «stops,» disposed at various places along the axis of the instrument. A «stop» is usually formed by a plane opaque screen, perpendicular to the axis, pierced by a round hole concentric with the axis. To an eye looking into the instrument from the side of the object, only such stops as lie in front of the first lens will be directly visible. Any other stop or lens-rim will be seen only by means of the real or virtual image of it that is cast by that part of the optical system which is between it and the eye. Now these impalpable stop-images, whether visible or not, are just as effective in cutting out the rays as if they were actual material stops; because, obviously, any ray that goes through an actual stop must necessarily pass, either really or virtually, through the corresponding point of the stop-image; whereas a ray that is obstructed by a stop, will not go through the opening in the stop-image.

If the optical instrument is directed toward the object and focussed on some selected point M on the axis, this point of the object will be reproduced in the image-space at the point M′ conjugate to M; and, on the assumption that the imagery is ideal, the transversal planes perpendicular to the axis at M and M′ are a pair of conjugate planes which play a very essential *rôle* in the theory of the imagery produced by an optical instrument. The plane in the object-space may be called the *focus-plane* (or the plane which is in focus on the «screen»), and the conjugate plane in the image-space may be referred to as the *screen-plane.*

Now if the eye is supposed to be placed at the axial object-point M and turned toward the instrument, the stop or stop-image whose aperture subtends at M the smallest angle is called the *entrance-pupil* of the system. All the effective rays in the object-space must be directed to points which lie within the circumference of the circular opening of the entrance-pupil. On the other hand, when the eye is placed at M′ so as to look into the instrument through the other end, the stop or stop-image which subtends the smallest angle at M′ determines in the same way the so-called *exit-pupil*, through which all the effective rays, when they emerge from the instrument, must pass, really or virtually. The exit-pupil is, in fact, the image of the entrance-pupil produced by the optical system as a whole, and the pupil-centres O, O′ are, therefore, a pair of conjugate axial points. The apertures of the ray-bundles in the object-space and image-space are determined by the diameters of the entrance-pupil and exit-pupil, respectively. Each of the pupils is the common base or cross-section of the cones of effective rays in the region to which it belongs.

Now if the cardinal points of the optical system are assigned, the image-relief corresponding to a 3-dimensional object may be constructed, as has been explained. This image-relief (as was stated above) is almost invariably received on a surface or screen of some kind, which may here be assumed to be a plane surface coincident with the so-called screen-plane. In the diagram (Fig. 6) the point M′ conjugate to the axial object-point M is represented as sharply focused on the screen. Evidently, the system cannot be in focus for all the different points of the object-relief at the same time, because the screen-plane is conjugate to only one transversal plane of the object-space, namely, the focus-plane perpendicular to the optical axis at M. Thus, for example, the reproduction of a solid object, such as the image of a landscape cast on the ground-glass plate of a photographic camera, is not an image at all in the strict sense of the word, inasmuch as it is not conjugate to the entire object point by point. Only such points of the object as happen to lie in the focus-plane will be reproduced by sharp point-images in the screen-plane; whereas object-points situated on one side or the other of the focus-plane will be depicted by small luminous areas which are sections cut out by the screen-plane from the cones of image-rays emanating originally from these points. These little patches of light, which are more or less elliptical in contour and whose dimensions depend on obvious geometrical factors, are the so-called *blur-circles*, in consequence whereof details of the image as projected on the screen are impaired to a greater or less degree or are, as we say, «out of focus.»

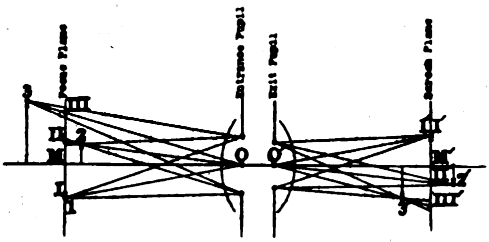


FIG. 6.

The object-figure in the focus-plane which is optically conjugate to this configuration of image-points and blur-circles cast on the screen may be easily constructed by projecting the points of the object on to the focus-plane by cones of rays which have the entrance-pupil as their common basis. This «vicarious» object to which the image on the screen is optically conjugate is sometimes called the «projected copy of the object-relief.»

It hardly needs to be said that the blur-circles which are incident to this mode of projecting the optical image of a solid object on a surface are due to no faults of the optical system itself, but are inherent in the method of representation and really have their origin in the object-space itself. The only possible way of diminishing or eliminating the indistinctness or lack of detail consists in reducing the diameter of the aperture-stop or, as we say, «stopping down» the instrument; until, finally, when the stop-opening is contracted more and more to the dimensions of a pin-hole, the pupils likewise will tend to become mere points at their centres O, O', and the blur-circles in both the focus-plane and the screen-plane will diminish in area *pari passu*, and ultimately collapse also into the points where the so-called *chief rays*, which intersect at the pupil-centres, cross this pair of conjugate planes. Under such circumstances, the pupil-centres O, O' are to be regarded as the *centres of perspective* of the object-space and image-space, respectively.

The extent of the *field of view* in the object-space is determined by that one of the stops or stop-images which subtends the smallest angle at the centre O of the entrance-pupil. It is called the *entrance-port*. Similarly, the field of view in the image-space is limited by the so-called *exit-port*, which is the stop or stop-image on that side of the instrument which subtends the smallest angle at the centre O' of the exit-pupil. Just as the exit-pupil is the image of the entrance-pupil, so also the exit-port is the image of the entrance-port produced by the optical system.

Aberrations.—As a matter of fact, actual optical images which are necessarily formed by ray-bundles of finite apertures are, in general, more or less faulty, so that the theory of optical instruments is greatly complicated by numerous practical and well-nigh insurmountable difficulties. These faults — which are called *aberrations* — may sometimes escape unnoticed merely because they are too slight for the eye to perceive, but usually the image will be seriously impaired unless they are corrected as far as possible. This is a subject which cannot be adequately treated here, and we can merely say that there are two principal kinds of aberration, namely, (1) the *chromatic aberrations* or color-faults of the image in consequence of the different refrangibilities of light of different colors, whereby the image is affected with residual color-effects which are not apparent in the object, and (2) the so-called *spherical aberrations* caused by the imperfect convergence of rays of light of the same color. A problem of the greatest difficulty in the design and construction of optical instruments is to determine the various factors (indices of refraction, radii of the surfaces, lens thicknesses and distances etc.) so that these defects will be at least comparatively negligible.

Newton erroneously concluded from his prism-experiments and investigations of dispersion of light that it was impossible to produce an achromatic image by refraction, and, despairing therefore of being able to improve refracting telescopes, he turned his attention to reflectors, as is well known. But in 1757 Dollond, a London optician, was able to construct an object-glass, which was achromatic for red and blue light, and which consisted of a combination of a «crown glass» lens with a «flint glass» lens, of which the former was the weaker in respect to both refraction and dispersion. For many years to come this remained the high-water mark of practical achievement in the construction of optical instruments, and indeed no further progress was possible on account of the lack of suitable varieties of optical glass. Fraunhofer clearly perceived the difficulty in the way of advancement in the manufacture of optical instruments, but it was not until the time of Abbe and the establishment in 1886 of the *Glastechnisches Laboratorium* of Schott und Genossen, where the now world-famous Jena glass is produced, that this obstacle was triumphantly overcome; and by the aid of the new kinds of optical glass it was possible to take another step in the correction of the chromatic aberrations by abolishing also the so-called «secondary spectrum» in the image.

In the older types of optical instruments (telescope and microscope), the first attempts at correcting the spherical aberrations were confined almost entirely to the improvement of the image of an object-point situated on the axis. With the development of the photographic lens and instruments with an extended field of view, it became more and more essential to take into account the other kinds of spherical aberrations as well as that along the axis. Among these may be mentioned *astigmatism* and "*coma*," which are concerned especially with lack of detail in the image, *curvature of the image*, which is fundamentally involved when the image has to be focussed on a receiving screen, and *distortion* due to the unequal magnification of the parts of the image which are at different distances from the axis. How these difficulties and defects have been practically surmounted in the best types of modern optical instruments is a record of painstaking achievement which cannot be described within the space allotted to this article.

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GEOMETRICAL PROGRESSION. A series of quantities is said to be in geometrical progression when the ratio of each term to the preceding is the same for all the terms, that is when any term is equal to the product of the preceding term and a factor which is the same throughout the series. This constant ratio or factor is termed the *common ratio*. See PROGRESSION.

GEOMETRIDÆ, jē-ō-mĕt'rĭ-dē, a family of moths whose larvæ walk by arching the body and so bringing the hinder feet (prolegs) close up to the forward (thoracic) feet, and again reaching forward. Hence they are called "loopers," "inch-worms," etc. See MEASURING-WORMS.

GEOMETRY, the science of the formal properties of the space in which we live, either in its concrete application to this space, or as a study of pure mathematical form; by extension, any one of an indefinite number of sciences which deal with mathematical systems more or less closely related to that of the space in which we live. The mathematician is only concerned with the purely formal and structural properties of the systems with which he deals (see MATHEMATICS), and in none of the following articles on various branches of geometry will we find any matters treated in detail except such as deal with this form. For a general treatment of the question of the relation of these forms to the space in which we live, see SPACE. For the several branches of geometry, see the articles immediately following.

GEOMETRY, Cartesian. Between number and the properties of number, on the one hand, and space and the properties of space, on the other, there is, strictly speaking, no *resemblance*; and the science of number, i.e., algebra or analysis, and the science of space, i.e., geometry, are essentially, psychologically, and logically independent doctrines. But despite their fundamental unlikeness and independence, there is between the two, broadly speaking, a fact-to-fact *correspondence*. For example, there subsists, or may be established, a unique and reciprocal, or one-to-one, correspondence between the real numbers and the points of a straight line or other curve; between the real numbers and the lines of a flat pencil (see PROJECTIVE GEOMETRY) or the tangents to a curve; between the pairs of real numbers and the points or the lines of a plane; between the triplets of real numbers and the circles of a plane or the points or planes of space; between the quartets (permutations four at a time) of the real numbers and the lines or the spheres of space. (See LINE GEOMETRY AND ALLIED THEORIES). The theory of the correspondence thus simply exemplified, the logically organic body of propositions setting it forth, is the *science* called analytic or algebraic geometry. It is often called co-ordinate geometry from the fact that the set of numbers determining or corresponding to a geometric element are called the co-ordinates of the element. By virtue of the correlation between analytic facts and geometric facts, it is frequently possible, when facts of the one type are known, to infer the corresponding facts of the other, and so to investigate space analytically (algebraically, arithmetically) and to investigate number geometrically. Under either of these aspects, analytical geometry appears as a *method*: analytic investigation of geometry, geometric investigation of analysis. Usually it is the former aspect under which the doctrine is regarded, geometry being the subject-matter, and analysis the means or instrument of research.

The science presents numerous branches or varieties. These differ among themselves in various ways. Two varieties may differ in respect to what is often called their "spaces," i.e., in respect to the domains, fields, regions, or extents (as curve, surface, space) containing the configurations with which they deal. Thus arise such distinctive designations as geometry of (on, in) a plane, or plane geometry, geometry on a surface or a curve, geometry of space. Again, a given "space" or domain may be conceived in countless ways. It may be conceived as the assemblage of its points or of its lines or of its circles, and so on. Accordingly two geometries relating to a same "space" or domain may yet differ in respect to their *primary* elements, in respect, i.e., to the elements of which the configurations investigated are regarded as composed. So arise, for example, such distinct theories as the point, line, circle, . . . , geometries of the plane, and the point, line, plane, circle, sphere, . . . , geometries of space. Once more, as will appear in this and related articles herein cited, a chosen element in any given domain may be referred to different kinds of configurations of reference; it may, in other words, be determined by, made to correspond to, or be associated with, different kinds of *co-ordinate systems*. Upon the choice of co-ordinate system depends, *ceteris paribus*, the analytic form of a given geometric theory. Accordingly, two geometries that are identical in content may differ in form, in algebraic guise or garb.

The primitive, by far the oldest, variety of analytic geometry, the parent of all other varieties, is the Cartesian, so called from its founder, René Descartes (1596–1650). Though originally a plane geometry, its procedure is equally adapted, and has been extended, to spaces of every dimensionality in points. (See HYPERSPACES). It is characterized partly by its primary element, the point, and partly by its co-ordinate system, which will be explained below. Descartes' geometry, contained in his *Discours de la méthode pour bien conduire sa raison et chercher la vérité, dans les sciences,* published in 1637, is to be regarded, on account of its influence on mathematics and upon knowledge in general, as one of the very greatest contributions ever made to science. Descartes was not indeed the first to apply algebra to geometry. That had been done by «the great geometer,» Apollonius of Perga (about 260–200 B.C.), who had referred the conic sections to their tangents and diameters, expressing the relations by linear equations between areas. In the 14th century Oresme and others had applied numbers («latitudo» and «longitudo,» precursors of the modern ordinate and abscissa) to refer a point to two chosen rectangular lines or axes. The point was confined, however, to the first quadrant. In this way the straight line, the circle and the parabola were studied. Other predecessors of Descartes were Vieta (1540–1603), Cavalieri (1598–1647), Roberval (1602–75), and the brilliant Fermat (1601–65), who more nearly than any other approaches Descartes in his understanding of the analytic method. Even Fermat, however, had apparently not seen what Descartes saw, the possibility of referring at once to a single co-ordinate configuration different curves of different orders.

The following paragraphs give a very brief account of the elements of Cartesian, or ordinary analytical, geometry with special reference to the straight line and the conic section and the simplest configurations of space.

The Plane.

Cartesian Co-ordinates.—Any two straight lines, as XX' and YY', are assumed as lines of reference, or *co-ordinate axes.* The former is X-axis or axis of *abscissæ,* the latter is Y-axis or axis of *ordinates.* The point O is the *origin* of *distances;* the (half) line OX, the *origin* of *angles.* Distances on or parallel to the X-axis are regarded *positive* (+) if measured *to the right, negative* (—) if *to the left.* Distances on or parallel to the Y-axis are regarded *positive* if measured *upward, negative* if *downward.* Angles are regarded *positive* or *negative* according as they are conceived to be generated by *counter-clockwise* or by *clockwise* rotation. (See TRIGONOMETRY). Conceive drawn all lines parallel to the X-axis and all parallel to the Y-axis. Any pair of these lines, one of the former set and one of the latter, determine

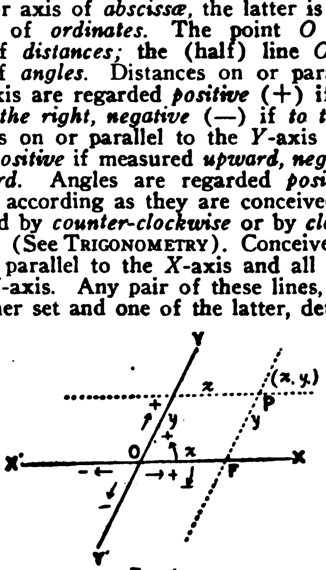

FIG. 1.

(intersect in) a point, and all points of the plane are thus determined. Conversely, any point determines (is the common point of) a pair of the lines, and all the pairs of the parallels are thus determined.. Obviously any line-pair or its *point* determines two real numbers: the distances OF and FP in terms of any convenient unit. These, denoted respectively by x and y, are named respectively the *abscissa* and the *ordinate,* together the *co-ordinates,* of the point. Conversely, any *pair* of real numbers determine a point. It is thus seen that, by means of a pair (system) of axes, a one-to-one correspondence is established between the *points* of the plane and the assemblage of real number *pairs.* Any such point and its pair of coordinates are said to *correspond;* the point is said to depict or represent its pair of numbers geometrically, and the number pair is said to represent the point arithmetically or algebraically or analytically.

Transformation of Cartesian Co-ordinates. — It is plain that (the unit being the same) the co-ordinates of a point referred to one pair of axes will not coincide with its co-ordinates referred to a different pair. Formulæ for expressing the old in terms of the new co-ordinates are exceedingly useful. To find such

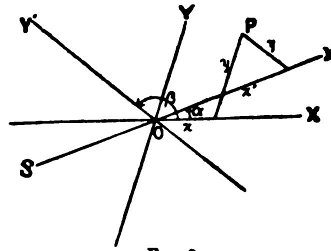

FIG. 2.

formulæ, consider first the case where the old and new origins coincide. Denote by α and β the angles made with OX by OX' and OY' respectively. Let x and y be the old, and x' and y' the new, co-ordinates of any point P, and denote the angle XOY by ω. The formulæ in question are readily seen to be: $x \sin \omega = x' \sin (\omega - \alpha) + y' \sin (\omega - \beta)$, $y \sin \omega = x' \sin \alpha + y' \sin \beta$. If the origins do not coincide and if h and k be the co-ordinates of the new origin O' with reference to the old axes, the formulæ of transformation are found by adding $h \sin \omega$ and $k \sin \omega$ respectively to the right-hand members of the foregoing equations. Most commonly the axes are assumed to be *rectangular.* In that case, $\omega = 90°$, $\sin \omega = 1$, $\beta = (90° + \alpha)$, and the equations of transformation become: $x = x' \cos \alpha - y' \sin \alpha + h$. $y = x' \sin \alpha + \cos \alpha + k$. The equations for effecting the *inverse* transformation are found by solving for x' and y' the equations of the *direct* transformation.

Polar Co-ordinates.— Though it is never necessary, it is often convenient to employ other than Cartesian co-ordinates to determine the position of a point. Of such other co-ordinate systems, the most familiar is the *polar.* About any point O (as centre), called the *pole,* suppose drawn all possible concentric circles; also suppose drawn out from the pole all possible *rays* (half-lines). Any circle and any ray determine (intersect in) a point, and all points of the plane are thus determined; conversely, any point determines (is common to) a circle and a ray, and all pairs of such lines (circle and ray) are thus determined. A circle is given by its radius ρ. and a ray by its angle θ made with a fixed ray, as OQ, called the *initial line* or *polar axis*. All the circles are obtained by letting ρ vary from θ to ∞, and all rays by allowing θ to vary from θ to 2π

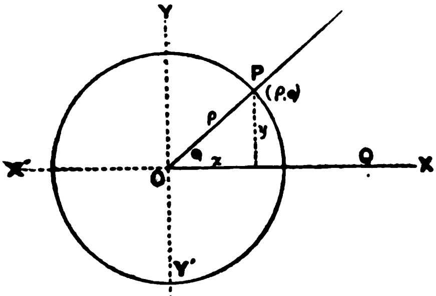

Fig. 3.

or 360°. Obviously, to any pair of values (within the ranges of variation mentioned) of ρ and θ there corresponds one point, and conversely. The pair of numbers (ρ, θ) determining or determined by a point P are called the *polar co-ordinates* of P. In particular, ρ is called the *radius vector*, and θ the *vectorial angle*, of P.

Transformations from Cartesian to Polar Co-ordinates.— We present here only the simplest and most important case, viz., that wherein the Cartesian axes are rectangular, the origin coinciding with the pole, and the positive half of the X-axis with the polar axis. Let P be any point. It is clear, Fig. 3, that the equations of direct transformation are: $x=\rho \cos \theta$; $\theta=\rho \sin \theta$. Solving these for ρ and θ, the equa-

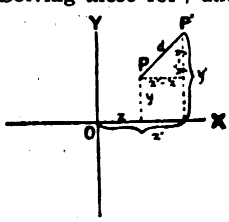

Fig. 4.

tions of the inverse transformation are found to be: $\rho=\sqrt{x^2+y^2}$; $\theta=\tan^{-1}\frac{y}{x}$.

Distance between Points.— Henceforth the axes will be assumed to be rectangular. Let P and P' be any two points, of co-ordinates (x, y) and (x', y') respectively. From Fig. 4, by the Pythagorean theorem, $d^2=(x-x')^2+(y-y')^2$, whence the distance between any two points (x, y) and (x', y') is found to be $d=\sqrt{(x-x')^2+(y-y')^2}$. Transforming to polar co-ordinates (ρ, θ) and (ρ', θ'), and reducing, there results $d=\sqrt{\rho^2+\rho'^2-2\rho\rho' \cos(\theta-\theta')}$, in agreement with the Law of Cosines. (See Trigonometry).

Division of Line-segment in Given Ratio. — Suppose P divides the segment P_1P_2 in the ratio, $m_1:m_2$. By hypothesis, $P_1P:PP_2=m_1:m_2$; hence, from similar triangles,

$$m_1:m_2=(x-x_1):(x_2-x)=(y-y_1):(y_2-y);$$

these equations, solved for x and y, yield

$$x=(m_1x_2+m_2x_1):(m_1+m_2)$$

and $y=(m_1y_2+m_2y_1):(m_1+m_2)$.

If the division be *exterior*, i.e., if P be *outside* the segment, as at (P), one term of the ratio is negative, and the formulæ are:

$$x=(m_1x_2-m_2x_1):(m_1-m_2),$$
$$y=(m_1y_2-m_2y_1):(m_1-m_2).$$

If P be the interior mid-point, $m_1=m_2$, and $x=(x_1+x_2):2$, $y=(y_1+y_2):2$. If $m_1=-m_2$, P is the exterior mid-point and its co-ordinates are both infinite unless the segment is parallel to an axis, in which case but one of the co-ordinates is infinite.

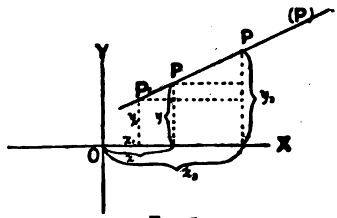

Fig. 5.

Locus of Equation.— An equation, $f(x, y)=0$, between the variables x and y, *defines* a system or aggregate or assemblage of *pairs* of numbers, viz., the assemblage of pairs of values of x and y that satisfy the equation. To each of such pairs of (real) values, a system of axes and a unit of distance being chosen, there corresponds a point. The assemblage of all the points so determined constitute the (real) *locus* of the equation. In general, as x or y varies continuously, y or x will vary continuously, and accordingly the corresponding point will trace a continuous path, some *curve*, the locus in question. Conversely, if a point move subject to some geometric condition, its path will be a curve such that the co-ordinates of its points and of no other satisfy some equation. An equation and its locus or curve are each said to represent the other, and, from the properties of either, corresponding properties of the other can be inferred. An equation defines its locus, a locus defines its equation. Any equation, $f(x, y)=0$, is, of course, satisfied by countless pairs of values of which either (or both) is imaginary or complex. To such a pair no real or "visible" point of the plane corresponds. Nevertheless, in order that the geometric and analytic languages shall be coextensive, it is customary to say that any pair of numbers of which at least one is complex represents an "imaginary point" of the plane. Accordingly the locus (in generalized sense) of an equation is composed of a real part and an imaginary part, the latter consisting of all imaginary points whose co-ordinates satisfy the equation. The intersection of two loci or curves consists of the points (real and imaginary) whose co-ordinates satisfy the equations of both curves. The foregoing remarks respecting equations in Cartesian co-ordinates apply equally to equations in polar co-ordinates.

The Straight Line and the Linear Equation.— Let (1) be any line through the origin, and denote by θ its angle with OX, and let $m=\tan \theta$. Obviously the x and y of any (every) point of (1) and of no other point are connected by the equation $y=mx$, which therefore defines, and is called the equation of, line (1). To each line through O there corresponds one value of the *slope* m, and conversely. Any line not through O is parallel to a line through O. Hence (2), parallel to (1), represents any line not through O. Clearly by adding b to any y of (1) the corresponding y of (2) is found, while corresponding x's are the same. Hence the equation of (2) is $y=mx+b$. The quantity b is called the *Y-intercept* of the line; if b is zero, (2) goes through O, and conversely. The equation represents a line for every pair of real values of m and b; conversely, every line

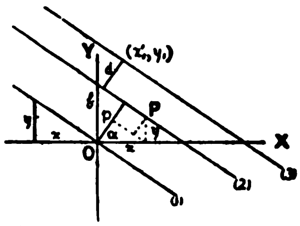

FIG. 6.

has a slope and a Y-intercept (positive or negative). Hence every equation of 1st degree in x and y represents a straight line, and conversely. Solving the equation $y=0$ of the X-axis and the equation of (2) as simultaneous, the intersection is found to be $\left(-\frac{b}{m}, 0\right)$, or $(a, 0)$, whence the equation of (2) may be written $\frac{x}{a}+\frac{y}{b}=1$, called the *intercept* or *symmetric form*, a being the X-intercept. The equation $y=mx+b$ is called the *slope form*. Other forms are readily obtainable, of which one of the most important is the so-called *standard* or *normal* form, $x \cos \alpha + y \sin \alpha - p = 0$, readily deducible from the figure, where p is the length of the perpendicular (normal) from O to (2), α is the angle indicated, and P is any point of (2). The *general* equation

$$Ax+By+C=0$$

can be reduced to any of the foregoing forms. To reduce it to the normal form, it suffices to multiply by the *normalizing factor*, $1:\sqrt{A^2+B^2}$, yielding

$$\frac{Ax}{\sqrt{A^2+B^2}}+\frac{By}{\sqrt{}}+\frac{C}{\sqrt{}}=0,$$

where $\cos\alpha=A:\sqrt{}$, $\sin\alpha=B:\sqrt{}$, $p=-C:\sqrt{}$, that sign before the radical being chosen which renders the constant (or absolute) term negative. A line is determined by yet other pairs of data, as by its slope m and a given point (x_1, y_1) or by two points (x_1, y_1), (x_2, y_2), and its equation assumes corresponding forms, which may be called respectively the *point-slope* form and the *two-point* form. The former plainly is $y-y_1=m(x-x_1)$. The necessary and sufficient *condition* that this line shall pass through (x_2, y_2) is $y_2-y_1=m(x_2-x_1)$. Combining the two equations by division, there results the two-point form, $(y-y_1):(y_2-y_1)=(x-x_1):(x_2-x_1)$, equation of the line fixed by the points (x_1, y_1), (x_2, y_2).

Distance from Point to Line.— The equation of any line (3), parallel to (2), Fig. 6, is $x \cos\alpha + y \sin\alpha - p'=0$, where $p'=p+d$. The condition that (x', y') be on (3) is $x' \cos\alpha + y' \sin\alpha = p'$. Subtracting p from both members, we find $d=x' \cos\alpha + y' \sin\alpha - p$, the distance from (x', y') to $x \cos\alpha + y \sin\alpha - p=0$.

Angle between Lines.— Let ϕ be the angle between two lines whose slopes are m_1 and m_2. Then $\tan\phi=\pm(m_1-m_2):(1+m_1m_2)$. If $\phi=0$, then $\tan\phi=0$, and $m_1=m_2$, condition of parallelism. If $\phi=90°$, then $\tan\phi=\infty$, and $1+m_1m_2=0$, whence $m_1m_2=-1$, condition of perpendicularity.

The Circle and Its Equation.— About any point (a, b) as center describe a circle of any radius r. Let $P(x, y)$ be any point of the circle. A glance at the figure shows that x and y are connected by the relation

$$(x-a)^2+(y-b)^2-r^2=0,$$

equation of the circle. By comparison with the equation $x^2+y^2+2Ax+2By+C=0$, the latter is found to represent a circle of center $(-A, -B)$, and radius $\sqrt{A^2+B^2-C}$. If the radicand be negative, the radius and hence

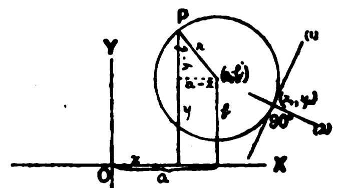

FIG. 7.

the circle is imaginary. The tangent (1) to the circle at the point (x_1, y_1) is

$$(x_1-a)(x-a)+(y_1-b)(y-b)-r^2=0;$$

the normal (2) is

$$(y_1-b)(x-x_1)-(x_1-a)(y-y_1)=0.$$

If the center be at the origin, the circle is $x^2+y^2=r^2$, the tangent at (x_1, y_1) is $x_1x+y_1y-r^2=0$, and the normal is $y_1x-x_1y=0$. The line $y=mx+c$ is tangent to $x^2+y^2-r^2=0$ when and only when the distance from O to the line is r, *i.e.*, when $c=\pm r\sqrt{1+m^2}$; hence $y=mx\pm r\sqrt{1+m^2}$ is tangent to the circle and as m varies completely envelopes the circle. Similarly it may be found that for every value of m the line $y-b=m(x-a)\pm r\sqrt{1+m^2}$ is tangent to the circle of center (a, b) and radius r. This equation (in slope form) of the tangent is sometimes called the *magic* equation of the tangent. By transformation of co-ordinates or otherwise the polar equation of the circle of center (ρ', θ) and radius r may be found to be $\rho^2-2\rho'\rho\cos(\theta-\theta')+\rho'^2-r^2=0$.

The Conic Sections: Ellipse, Parabola, Hyperbola.— The equation of the path, locus, or curve generated by a point (x, y) which so moves that the ratio of its distance from a fixed point (called the *focus*) to its distance from a fixed straight line (called the *directrix*) is a constant e (called the *eccentricity*) is of the form $Ax^2+By^2+Cxy+Dx+Ey+F=0$; conversely, the locus of every equation of second degree is a curve of the kind in question. All such curves are called *conics* or *conic sections*, because any one of them is the intersection of a plane and a cone, where by cone meant the surface that may be generated by a straight line revolving about a fixed point (vertex) and making a constant angle with a fixed line (axis) through the point; conversely, every such intersection is a conic, curve of second degree. The conics, of the very greatest importance alike in pure and in applied mathematics (cf. ASTRONOMY), were studied by the ancients (cf. APOLLONIUS), who conceived them as intersections of plane and cone. There are three species of conics, a conic being named *ellipse* (E), *parabola* (P), or *hyperbola* (H), according as the eccentricity $e <, =,$ or > 1. The foregoing equation represents an E, a P, or an H, according as $4AB - C^2$ is *positive, zero,* or *negative.* Among the conics of any species are *degenerate* or *degraded* or so-called *improper* conics of that species. The degraded form of E is any pair of imaginary straight lines intersecting in a real point (center of the conic, vertex of the cone); any pair of parallel real straight lines is a degraded P; and any pair of non-parallel real lines is a degenerate H. By suitable transformations of co-ordinates the equation of any conic may be made to assume a simplest, named *standard,* form. The standard forms of the species are presented below.

Ellipse.— The standard form of the E is $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$, in which a is the half *major* and b the half *minor, axis* of the E. The focus and directrix are respectively F and DD or F' and $D'D'$. The equations of the directrices are $x = \pm a:e$; $e = c:a$. The sum of the focal radii of any point of E is $\rho + \rho' = 2a$, a property often taken as definition of the E, instead of the relation $\rho = ed$. If $b = a$, the E is a circle; hence the circle is an E of coincident

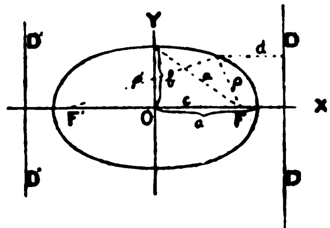

FIG. 8.

foci and eccentricity zero. The area of E is πab.

Hyperbola.— The standard equation is $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$, where a is half of the *transverse,* and b is half of the *conjugate, axis.* The equation represents the curve composed of the two branches (1) and (2). For any point, $\rho' - \rho = 2a$, a defining property of the H. The H composed of (1′) and (2′) is called *conjugate* to the other one and has $\frac{x^2}{a^2} - \frac{y^2}{b^2} = -1$ for its equation. The two oblique lines through O *tangent* to both H's at ∞ are named *asymptotes* of the curves. The equations of the asymptotes are $y = \pm \frac{b}{a} x$. The corresponding lines of the E are imaginary, $y = \pm i \frac{b}{a} x$. If $a = b$, the H, $x^2 - y^2 = a^2$, is called equiaxial or equilateral or *rectangular,* its asymptotes being at right angles. It is related to the general H as the circle to the general E.

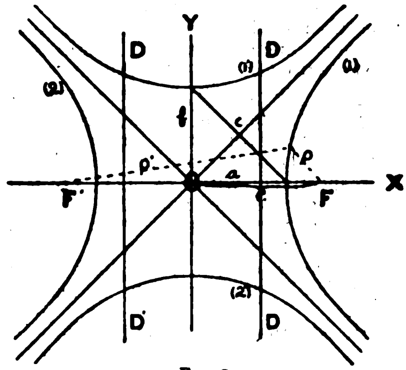

FIG. 9.

Parabola.— The standard equation is $y^2 = 4px$. The equation of the directrix is $x = -p$; the co-ordinates of the focus are $(p, 0)$; for any point $\rho = d$. The second focus and the center lie at ∞ on the axis of the curve.

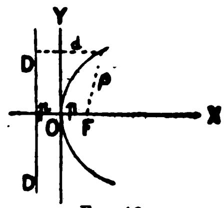

FIG. 10.

For some account of plane curves of higher order or degree, see the article HIGHER PLANE CURVES, and for elaborate and detailed treatment of the analytical geometry of the plane, including exhaustive discussion of the conics, see works cited in bibliography below. We add here a note introducing the Cartesian geometry of

SPACE.

Co-ordinate Configurations.— Space is tri-dimensional in points, three independent data being necessary and sufficient to determine the position of a point. Of such data the simplest are the distances, Cartesian rectangular *co-ordinates,* x, y, z, of a point P from three fixed planes XOY, YOZ, ZOX, each perpendicular to the other two. These *co-ordinate planes* determine three lines, called *co-ordinate*

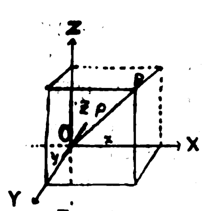

FIG. 11.

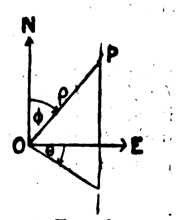

FIG. 12.

axes, having a common point O, the *origin.* Positive directions are indicated by the arrowheads. The cylindrical co-ordinates of a point P are z and a set of ordinary polar co-ordinates

ρ and ϑ taking the place of x and y in the XY plane. The polar co-ordinates of a point P, Fig. 12, are the radius vector ρ, and the vectorial angles θ and ϕ, reckoned respectively from the pole O and the *polar axes* OE and ON. If the pole coincide with the origin, and the polar axes with OX and OZ, then $x=\rho \cos\theta \sin\phi$, $y=\rho\sin\theta\sin\phi$, $z=\rho\cos\theta$, $\rho=\sqrt{x^2+y^2+z^2}$, $\tan\theta=y:x$, $\cos\phi=z:\rho$, formulæ of transformation from one system to the other. If a, β, γ, are the direction angles (made respectively with OX, OY, OZ) of the radius vector ρ of any point P, Fig. 11, then $x=\rho\cos a$, $y=\rho\cos\beta$, $z=\rho\cos\gamma$, and $1=\cos^2 a+\cos^2\beta+\cos^2\gamma$, sum of squares of *direction-cosines* of ρ. Any linear equation $Ax+By+Cz+D=0$ represents a plane. The symmetric equation of a plane is $\frac{x}{a}+\frac{y}{b}+\frac{c}{z}=1$, a, b, c being the axial intercepts extending from O to the plane. In normal form the equation of the plane is $x\cos a+y\cos\beta+z\cos\gamma=p$ where p is the length, and $\cos a, \cos\beta, \cos\gamma$ are the direction-cosines, of the perpendicular from O to the plane. To convert $Ax+By+Cz+D=0$ to the normal form it suffices to multiply it by the normalizing factor, $1:\sqrt{A^2+B^2+C^2}$, the new coefficients $A:\sqrt{\ }$, $B:\sqrt{\ }$, $C:\sqrt{\ }$, being $\cos a$, $\cos\beta$, $\cos\gamma$, and $D:\sqrt{\ }$ being $-p$. The angle Θ between two planes $Ax+By+Cz+D=0$ and $A'x+B'y+C'z+D'=0$ is determined by the relation

$$\cos\theta=(AA'+BB'+CC'):\sqrt{(A^2+B^2+C^2)(A'^2+B'^2+C'^2)},$$

whence the planes are parallel when and only when $A:A'=B:B'=C:C'$, and are perpendicular when and only when $AA'+BB'+CC'=0$. The equations of any two of the planes containing a line, *together* represent the line. Accordingly in space the line has *two* equations. Its simplest equations are those of any two of the three planes containing the line and being perpendicular respectively to the co-ordinate planes, as $x=mz+p$, $y=nz+q$. Such a pair are unsymmetric. Symmetric equations of the line directed by a, β, γ, and going through the point (x_1, y_1, z_1) are

$$(x-x_1):\cos a=(y-y_1):\cos\beta=(z-z_1):\cos\gamma$$

in number three of which but (any) two are independent. The angle θ between two lines whose direction-cosines are proportional to L, M, N and L', M', N', respectively, is determined by the relation

$$\cos\theta=(LL'+MM'+NN'):\sqrt{(L^2+M^2+N^2)(L'^2+M'^2+N'^2)},$$

whence the lines are parallel if and only if $L:L'=M:M'=N:N'$, and are perpendicular if and only if $LL'+MM'+NN'=0$. The angle θ between a line of direction-cosines proportional to L, M, N and a plane

$$Ax+By+Cz+D=0$$

is given by the relation

$$\sin\theta=(AL+BM+CN):\sqrt{(A^2+B^2+C^2)(L^2+M^2+N^2)},$$

whence the line and plane are parallel if and only if $AL+BM+CN=0$ and are perpendicular if and only if $A:L=B:M=C:N$. The necessary and sufficient condition that the line $x=m_1z+p_1$, $y=n_1z+q_1$, shall intersect the line $x=m_2z+p_2$, $y=n_2z+q_2$, is that $(m_1-m_2):(n_1-n_2)=(p_1-p_2):(q_1-q_2)$.

The literature of the analytical geometry of space, herewith barely introduced, is extensive. For some account of further developments of the subject, see SURFACES, THEORY OF; CURVES OF DOUBLE CURVATURE. In the doctrine above introduced the point is employed as element. Some account of the theories that arise on choosing for element some other geometric entity, as the plane, the line, the sphere, etc., may be found in the articles, GEOMETRY, MODERN ANALYTICAL, and GEOMETRY, LINE, AND ALLIED THEORIES, in this work.

Bibliography.— College text-books of analytical geometry abound. One of the scientifically best American texts is W. B. Smith's 'Coordinate Geometry.' The most comprehensive English works are Salmon's 'Conic Sections' and 'Geometry of Three Dimensions' (both of which have been translated into French by O. Chemin, and supplemented and translated into German by Wilhelm Fiedler), and Frost's 'Solid Geometry.'

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GEOMETRY, Elementary. Geometry is the science of space. Its object is the study of the properties of forms (configurations, figures) of every conceivable kind. The subject is thus endless in two ways: in the first place, the number of configurations is infinite — this is so even if we restrict ourselves to curves and surfaces; in the second place, any one type of figure has an inexhaustible variety of properties.

Elementary geometry may be roughly described as the study of the simpler or more evident properties of the simpler configurations. Specifically, the title refers to the body of geometric truths incorporated by Euclid in his famous 'Elements.' The text-books on elementary geometry used throughout the civilized world for the last 20 centuries are in fact merely revisions of the 'Elements'; so that the subject itself is often referred to, especially in England, as the study of Euclid. The majority of the theorems refer to points, straight lines, and planes, with their combinations. Of curves, only the circle is considered, and of surfaces those related to the circle (spherical, cylindrical, conical).

It is not the object of this article to give a résumé of the standard theorems of elementary geometry, but rather to indicate some of the more significant general features, especially in the light of the more recent developments.

LOGICAL FOUNDATIONS.

The most prominent aspect of elementary geometry is the logical aspect: a great number of propositions, termed theorems, are deduced from a comparatively few propositions assumed at the outset and termed axioms or postulates. In the ideal treatment of the subject, all the assumptions should be enumerated explicitly, so that, if the question is asked, "Are the theorems of geometry true," the mathematician can answer correctly, "Yes, if my postulates are true.» As to whether the postulates are true, that is not a matter for the mathematician as such to consider, but rather comes within the province of the physicist, psychologist or philospher.

The ordinary course in geometry, modeled after Euclid, does not carry out this ideal. Assumptions are continually being made as they may be needed for the purpose of proof, in addition to those explicitly enunciated as axioms and postulates. For example, in the first proposition of Euclid, dealing with the construction of an equilateral triangle on a given segment AB, circles are drawn with centres A and B and common radius AB, and it is then assumed that these circles intersect. The only justification given is the diagram or the appeal to spatial intuition. Again, in dealing with the congruence of triangles, it is assumed that a triangle may be moved about without altering its sides or angles, though the stated axioms do not even mention displacement. In spite of himself, Euclid's treatment is (partly) physical or intuitional, instead of purely mathematical, that is, purely logical.

It is only within the last few years that the ideal has been (practically) attained; that is, a set of explicit assumptions (termed axioms or postulates indifferently) drawn up, from which the propositions of ordinary geometry follow by purely logical processes. Geometry becomes then a branch of pure mathematics. As Poincaré expresses it, in this ideal treatment «We might put the axioms into a reasoning apparatus like the logical machine of Stanley Jevons, and see all geometry come out of it.»

Many contributors have aided in this development, among whom may be mentioned Gauss, Lobachevsky, Pasch, Veronese, and especially Peano and his coworkers in symbolic logic, Pieri and Peano. The first elaborately worked out system is that of Hilbert (1900). We give a brief account of his axioms. Since then Veblen and Huntington in this country have developed much clearer and simpler systems. Consult Veblen, O., 'A System of Axioms for Geometry' (trans. Am. Math. Soc. 1904).

Geometry deals with three systems of objects or elements termed *points, lines* (used here in sense of straight lines), and *planes*, connected by certain relations expressed by the words *lying in, between*, etc. It is not necessary for the development of the subject that these words should suggest visual images; in fact the concrete nature of the elements and relations is to be eliminated from the discussion. To emphasize this abstract aspect, it is convenient to use symbols, say capital letters for points, Roman minuscules for lines, and Greek letters for planes. The axioms are arranged in five groups as follows:

I. *Axioms of Association or Connection.*— 1. Any two different points A, B determine a line a. (Such points are then said to lie on the line.)

2. Any two different points on a line determine that line.

3. In any line there are at least two points, and in a plane there are at least three points not on a line.

4. Any three non-collinear points A, B, C determine a plane α.

5. Three non-collinear points of a plane determine that plane.

6. If two points A, B of a line a are in a plane α, then every point of a is in α. (The line is then said to lie in the plane).

7. Two planes α, β which have a point A in common have at least a second point B in common.

8. There exist at least four points not in one plane.

II. *Axioms of Order.*— These deal with the relation expressed by the term *between*.

1. If A, B, C are points of a line and B is between A and C, then B is between C and A.

2. If A and C are points of a line a, then there exists on a at least one point B between A and C, and at least one point D such that C is between A and D.

3. Of any three collinear points, one and only one is between the other two.

These three axioms deal with the line, while the fourth deals with the plane.

4. If A, B, C are any three non-collinear points, and a is a line in their plane passing through a point of the segment AB, but not through A or B or C, then a contains a point of either the segment AC or the segment BC.

III. *Axioms of Congruence.*— The first five axioms of this group relate to congruent segments and congruent angles. For example, a segment AB is congruent to itself and to the reversed segment BA; and segments congruent to the same segments are congruent to each other. Finally, the sixth is a metrical axiom concerning triangles: if two sides and the included angle of one triangle are congruent respectively to two sides and the included angle of another triangle, then the remaining angles are also congruent.

The fact that the remaining sides are congruent is not included as a part of the axiom because it may be proved. The other cases of congruent triangles are theorems. In Euclid the above statement is a theorem, but this is possible, as already observed, merely on account of unstated assumptions relating to displacement. Euclid's axiom that all right angles are congruent, in Hilbert's system becomes a theorem.

IV. *The Axiom of Parallels.*—This contains only the so-called *Euclidean axiom*, in the form: Given a line a and a point A not on a, then in the plane α determined by a and α there is only one line through A which does not intersect a.

V. *Axioms of Continuity.*— The continuity notion is analyzed into two parts of which the first (1) is stated in the axiom *Archimedes*. 1. On a straight line consider any two points A, B and a point A_1 between them; construct the points A_2, A_3, ..., in order, so that A_1 is between A and A_2, A_2 between A_1 and A_3, etc., and so that the segments AA_1, A_1A_2, A_2A_3, ..., are congruent; then among the points so constructed there exists a point A_n such that B is between A and A_n. That is, by repeatedly laying off a given segment however small any assigned point of the line will be passed after a finite number of steps.

This axiom is sufficient for the development of the usual theorems of geometry. However the space to which the theorems apply would not be continuous in ordinary sense. It would in fact contain only those points of the space considered in analytical geometry whose co-ordinates are rational or expressible by radicals of the second order. To identify with continuous space it is necessary to add a final axiom (2) relating to convergent point sets, or else the so-called axiom of completeness which states that the system of elements (points, lines, planes) cannot be enlarged by adjoining other elements in such a way that all the previous axioms are preserved.

The fact that this set of axioms is sufficient is shown by actually deducing the usual body of theorems. This is done in Hilbert's 'Grundlagen.' Diagrams are here used, it is true, but only for convenience; the proofs can be given without any reference to the diagrams. Often the deduction of those results which are evident to the intuition is long and complicated. This is the case, for example, in showing that a triangle (or any simple polygon) has the properties expressed by the terms inside and outside. It must be shown from the axioms that the given triangle brings about a division of the points in its plane into three classes, namely, points P, points I, and points O, such that any two I points or any two O points may be connected by a broken line not containing any P point, while any broken line from an I point to an O point necessarily contains P points. To the intuition, of course, the P points are the points on the perimeter of the triangle, the I points are those inside, and the P points are those outside.

In the development it is important to observe that some theorems depend upon only part of the axioms. Thus from group I alone it follows that two planes having a point in common necessarily have a line in common, and that a line and a point determine a plane. The property of triangles and polygons stated above follows from group I and II. The theory of proportion may be established without employing group V. The theorem that if two triangles in one plane have their sides respectively parallel, the lines joining corresponding vertices are either parallel or concurrent (a special case of *Desargues'* theorem), can be proved without using axiom III 6 if and only if the spatial axioms in addition to the plane axioms are employed.

An important result which has been obtained recently is that while the areas of plane polygons may be treated without appealing to the continuity axioms, this is not possible with the volumes of polyhedrons. The difference is observed in Euclid's proofs: the proposition that triangles having the same base and altitude are equal in area is demonstrated by adding or taking away congruent parts from congruent figures, while the corresponding proposition concerning triangular pyramids is proved by the method of limits, or the equivalent method of exhaustion. That this difference in treatment is not avoidable was established by Dehn (1901), who showed that there exist polyhedrons of equal volumes which cannot be formed by the addition or subtraction of respectively congruent polyhedrons. In plane geometry this formation applies to any two polygons with the same area.

The most fundamental question concerning the set of axioms is that of *consistency*. In the development of geometry no contradiction has thus far presented itself; but will this always be the case? Can it be shown that no inconsistency can ever arise? The only known method of answering this question depends upon establishing a correspondence between the geometrical elements and certain numerical entities, and showing that any inherent contradiction in geometry would involve contradictory relations among these entities. The question is thus transferred to the field of arithmetic. Are the axioms of number (commutative, associative, distributive, etc.) inconsistent? No perfectly satisfactory disproof of this has yet been devised. See however ALEGEBRA: DEFINITIONS AND FUNDAMENTAL CONCEPTS.

Another question to be considered is the independence of the axioms. If any one axiom can be deduced from the others, it may be omitted from the list and introduced as a theorem. It is therefore desirable that the axioms should express mutually independent statements. The standard method employed in proving the independence of an axiom or group of axioms consists in devising a set of objects of any kind which, when considered as elements, fulfill the relations expressed in remaining axioms, but for which the axiom or group in question is not satisfied. Thus the fact that the axiom of parallels (IV) cannot be deduced from the other axioms is shown by the non-Euclidean geometry of Lobachevsky. Similarly, the independence of axiom VI is proved by means of the non-Archimedean geometries of Veronese and Hilbert. Various apparently artificial systems have been devised in this connection, which, while not amenable to the intuition, are conceivable and mathematically true because based on assumptions which may be shown to be free from inconsistency.

The set of axioms presented above is of course not the only one which may serve as foundation for ordinary geometry. Thus the axiom of parallels may be replaced by the statement that the sum of the angles of a triangle is two right angles. In general the propositions of a given collection may be derived from various sets selected from the total collection. In the present case the possibilities are endless.

Geometry may also be founded on other primative (undefined) concepts than those introduced above. Thus in the discussions inaugurated by Helmholtz and continued by Lie and Poincaré, the principal concept is that of transformation (displacement, rigid motion) and the axioms include the group property (the resultant of two displacements is itself a displacement). The straight line is then no longer, as in Hilbert's system, a primitive concept, but receives definition: if in a displacement two points are fixed, there are an infinite number of fixed points forming, by definition, a straight line (the axis of rotation).

In the usual intuitional treatment the concept of general surface is assumed as a starting-point and the plane is then defined as a surface such that if any two of its points are joined by a straight line, the latter lies entirely in the surface. This obviously states more than is required for the determination of the surface. To meet this objection the plane is sometimes defined as generated by drawing straight lines from a fixed point A to all the points of a straight line a. To obtain the entire plane it is necessary to add the line through A parallel to a. This definition is therefore unsatisfactory, because parallel lines require in their definition the previous definition of the plane. Peano has met the difficulty by this definition: Consider three fixed points A, B, C not in a straight line; take a fixed point D within the segment BC, and on the segment AD take a fixed point E; a plane is then generated by the lines (rays) from E to every point of the perimeter ABC. It may then be proved that a straight line connecting any two points of such a surface lies on the surface.

Problems and Constructions.

The only instruments whose use is implied in the postulates of elementary geometry are the ruler (straight-edge), for drawing straight lines, and the compass, for drawing circles. Only those problems are considered as coming within the domain of elementary geometry which can be solved by a finite number of operations with these instruments. Such constructions are termed *Euclidean*, or sometimes simply *geometric*. An example is the construction for bisecting an angle. With the vertex V as centre and any radius describe a circle cutting the sides of the angle in points A and B; with these points as centres and any (sufficiently large) radius describe circles intersecting in points C and D; the line joining C and D necessarily passes through V and bisects the given angle.

However, many problems arise which cannot be solved in this way. A well-known example is the problem of trisecting an angle. For centuries the Greek geometers and their followers sought for a solution; only within the present century has it been shown that such attempts must necessarily fail. The statement that the problem is impossible does not deny that lines trisecting the given angle exist, but means simply that such lines cannot be obtained by a construction employing a finite number of straight lines and circles.

No one has yet succeeded in demonstrating this impossibility by purely geometric means. The question arises naturally in elementary geometry, but apparently cannot be answered by elementary methods. We give now an outline of the algebraic method for deciding whether a given problem comes within the class of possible or the class of impossible problems.

Any line segment may be represented by a segment, namely, the ratio of the given segment to an assumed unit segment. Conversely, any number then represents a segment. Consider now the elementary operations of arithmetic or algebra in relation to geometric constructions.

If a and b denote given segments, or the corresponding numbers, the sum $a+b$ is constructed by transferring the segment b, by means of the compass, so that it is collinear and adjacent to a. The difference $a-b$ is also readily constructible.

The product $x=ab$ may be defined by the proportion $1:a=b:x$. The proper construction is then suggested by the theorem that a line parallel to the base of a triangle divides the sides proportionally. Draw any triangle with 1 and a as two of the sides; along the first

side prolonged if necessary lay off segment b; from the terminal point draw a line parallel to the base of the triangle; this cuts off on the second side a segment equal to the required x. The quotient $y=a/b$ is obtained similarly from the proportion $b:1=a:y$. Hence all rational expressions, that is, expressions formed by a finite number of additions, subtractions, multiplications, and divisions are constructible.

Furthermore, extraction of square roots is possible. For $z=\sqrt{a}$ may be defined by $1:z=z:a$. Hence if on $1+a$ as diameter a semicircle is described, the perpendicular at the end of the unit segment is the required z. Therefore,

Theorem I.— Any expression involving only rational operations and the extraction of square roots can be constructed with ruler and compass.

Expressions which cannot be reduced to this form cannot be constructed. This we now prove in the form of the converse:

Theorem II.— Any segment which can be constructed with ruler and compass is expressible algebraically by rational operations and the extraction of square roots.

For any such construction consists in drawing a finite number of straight lines and circles and finding their intersections. Employing Cartesian co-ordinates (see Geometry, Cartesian), the equation of a straight line is of the form $ax+by+c=0$, and that of a circle is of the form $x^2+y^2+ax+by+c=0$. The intersection of two straight lines leads to the solution of two equations of the first degree, which requires only rational operations. The intersections of a straight line and circle, or of two circles, depends on the solution of quadratic equations and leads to radicals of the second degree.

We proceed to apply these theorems to several examples.

Consider first the problem of bisecting an angle. The given angle θ and the required angle $\frac{\theta}{2}$ may be determined by their cosines.

Let $a=\cos\theta$ and $x=\cos\frac{\theta}{2}$ From trigonometry $\cos\theta=2\cos^2\frac{\theta}{2}-1$, that is, $2x^2-1=a$.

Hence $x=\sqrt{\frac{1+a}{2}}$. Therefore, by Theorem I, the problem is elementary. The formula also indicates a definite method of construction.

In the *trisection* of a given angle we require the formula $\cos\theta=4\cos^3\frac{\theta}{3}-3\cos\frac{\theta}{3}$. Here $\cos\theta=a$ is known, and $\cos\frac{\theta}{3}=x$ is required. The equation of the problem is

$$4x^3-3x-a=0.$$

When solved by Cardan's formula this leads to cube roots. But before Theorem II can be applied it must be shown that no expression involving only square roots can satisfy the equation. This is true in the present case by the following general theorem taken from the theory of equations:

Theorem III.— An irreducible equation whose degree is not a power of two cannot have a root expressible by radicals of the second degree. (The term irreducible equation is here employed to describe an equation $f(x) = 0$ with rational coefficients whose left member cannot be factored rationally).

In general the algebraic questions which arise in this connection require for their complete discussion the powerful Galois Theory of Equations. See EQUATIONS, GALOIS' THEORY OF.

A second of the so-called famous problems of elementary geometry is the *Delian problem,* of the duplication of the cube. Given a cube with side a, to construct a cube with side x having double the volume. The equation of the problem is $x^3 = 2a^3$. Theorem III and then Theorem II apply. The corresponding problem concerning the square, leading to the equation $x^2 = 2a^2$, is easily solved: the side of the required square is simply the diagonal of the given square.

Regular Polygons.— The construction of a regular polygon of n sides is equivalent to the division of a given circumference into n equal arcs. The only cases treated by Greek geometers and the ordinary text-books are, for prime numbers, $n = 3$ and $n = 5$; from these constructions of the regular triangle and pentagon, combined with the construction for bisecting an angle, the constructions for the cases 2^κ, $3 \cdot 2^\kappa$, $5 \cdot 2^\kappa$, $3 \cdot 5 \cdot 2^\kappa$, where κ is any integer, are easily found.

No advance was made, that is, no new constructible polygons were discovered, until Gauss, about a century ago, applied the algebraic method. The equation of the problem may be put into the form

$$x^{n-1} + x^{n-2} + \ldots + x + 1 = 0,$$

which is then termed the *cyclotomic equation.* When n is a prime number the equation is irreducible. Hence by Theorem III the construction is possible only when $n - 1$ is a power of 2. That is, n must be of the form $2^\mu + 1$. Prime numbers of this type are necessarily of the form $2^{2^\nu} + 1$, and are known as *Fermat primes.* The values $\nu = 0$ and $\nu = 1$ give the familiar cases $n = 3$ and $n = 5$; the first new case, arising from $\nu = 2$, is $n = 17$. The construction for the regular polygon of 17 sides is complicated, but the steps are indicated definitely by the algebraic solution of the cyclotomic equation, which is in fact solvable by square roots.

The general result on regular polygons is as follows: The regular polygon of n sides can be constructed with ruler and compass if, and only if, the prime factors of n are 2 repeated any number of times and distinct Fermat primes.

The first impossible cases are $n = 7$ and $n = 9$.

Quadrature of the Circle.— This most famous problem of geometry requires the construction of a square having the same area as a given circle. That this is impossible (that is, that the construction cannot be effected with the ruler and compass) was not definitely shown until 1882, although the failure of innumerable attempts had led many to suspect the true result. The *rectification* of the circle, that is the construction of a straight line having the same length as a given circumference, is an equivalent problem, and hence also impossible. This is so on account of the theorem that the area of a circle equals one-half of the product of the radius into the circumference.

The ratio of the circumference to the diameter is the same for all circles: the constant thus arising has been generally denoted by the symbol π since the time of Euler. It was proved quite simply by Legendre that π is not rational (i.e., cannot be represented exactly by the ratio of any two integers, and hence, in particular, cannot be represented by a terminating decimal). The difficulty consists in showing that π is *transcendental,* that is, is not the root of any algebraic equation

$$a_0x^n + a_1x^{n-1} + \ldots + a_n = 0,$$

where n is a positive integer, and the coefficients are any integers. This was finally proved by Lindemann in 1882, after Hermite in 1873 had shown that e, the base of the Napierian system of logarithms, is transcendental. The two numbers are connected by the remarkable relation $e^{i\pi} = -1$, where i is the imaginary unit number $\sqrt{-1}$. Since π cannot satisfy any algebraic equation, it certainly cannot be expressed by square roots. Hence Theorem II proves the impossibility.

Approximate Constructions.— The problems considered cannot be solved exactly by ruler and compass, but they can be solved to any required degree of approximation. Thus a simple approximate solution of the rectification problem is the following: Let O be the centre and AB any diameter of the given circle. At the middle point E of AO construct a perpendicular cutting the circumference in C and D. On AB prolonged lay off $EF = CD$. Draw FD, and on this line lay off $FH = AB$. Then the segment HD is approximately one-fourth the circumference. The error is less than one part in 5,000.

Other Instruments.— The problems considered may be solved exactly if other instruments in addition to ruler and compass are allowed. Thus the trisection and duplication problems (like all problems depending on cubic and biquadratic equations) can be solved by the instruments for drawing parabolas or other conics, or by appropriate linkages. The quadrature of the circle, being a transcendental problem, cannot be effected by any instrument which draws algebraic curves. It can be solved by various transcendental curves (quadratrix, sinusoid, cycloid); or by the integraph (an instrument which draws the curve $y = \int f(x)\,dx$, where $y = f(x)$ is a given curve).

We consider now various restrictions which may be imposed on Euclidean constructions.

(1) Ruler Constructions.— Here only the straight-edge is allowed. For the possibility of such a construction it is necessary but not sufficient that the corresponding algebraic expression should be rational. If two parallel lines are given, then through a given point a line may be drawn parallel to given lines by a ruler construction. But this is not the case when a line is to be drawn through a given point parallel to a given line. The impossibility proof, based upon projection, may be carried out by pure geometry.

(2) **Mascheroni Constructions.**— Here only the compass is allowed. A straight line is considered as known when two of its points are determined. Mascheroni, in 1797, showed that all problems which can be solved by the ruler and compass can be solved by the compass alone.

(3) **Poncelet and Steiner** have shown that if a single fixed circle with its centre is given, all elementary constructions may be carried out by means of the straight-edge. Again, if a ruler with parallel edges may be employed (it is then, for instance, possible to place the instrument so that each edge goes through an assigned point), all elementary problems may be solved without the compass.

(4) **Hilbert** considers constructions with the straight-edge and *sect-carrier*. The latter denotes a compass used not to draw circles, but merely to lay off a given segment on a given line. All such constructions can be carried out by the straight-edge and a movable unit sect. The test for deciding the possibility or impossibility of a problem in this sense is exceedingly complicated, depending on the higher theory of algebraic numbers.

Geometrography.— A problem of elementary geometry can usually be solved in a variety of ways by the rule and compass. Thus for the Apollonian problem (to construct a circle touching three given circles) over 100 distinct solutions have been worked out (Apollonius, Poncelet, Steiner, Lemoine, Study, etc.). How can we compare these as regards simplicity? It is necessary to adopt some standard or measure of simplicity. One method, for instance, would be to take the number of lines and circles as the measure of simplicity.

A more complete (but still somewhat artificial) discussion has been elaborated by E. Lemoine in his 'Geometrography.' Constructions are analyzed into the following elementary operations: Operation C_1 consists in placing one point of the compass on a given point in the plane of construction; including a given length between the points of the compass is then denoted by $2C_1$; placing a point of the compass on an undetermined point of a line is operation C_2; drawing a circle is C_3; making the edge of the ruler pass through an assigned point is operation R_1, and through two assigned points is $2R_1$; finally, drawing a straight line is operation R_2. Any construction may then be represented by a symbol $l_1R_1 + l_2R_2 + m_1C_1 + m_2C_2 + m_3C_3$, where the coefficients represent the numbers of elementary operations involved. The *simplicity* is measured by $l_1 + l_2 + m_1 + m_2 + m_3$, and the *exactness* by $l_1 + m_1 + m_2$ (the preparatory operations). The number of lines employed is given by l_2 and of circles by m_3. In case of construction for the bisection of an angle explained above the symbol is $3C_1+3C_3+2R_1+R_2$. The construction which leads to the smallest possible value for the *simplicity* is termed the geometrographic solution. There may be more than one solution of this kind.

Bibliography.— Casey, 'Sequel to Euclid' (Dublin 1888); Euclid, 'Elements' (Editions by Hall and Stevens, Harper, Nixon, Todhunter, etc.); Hadamard, 'Leçons de géométrie élémentaire' (2 vols., Paris 1898, 1901); Hilbert, 'Grundlagender Geometrie' (Leipzig, 1899, 2d ed., 1901); translation by Townsend (Chicago 1900); Halsted, 'Rational Geometry' (New York 1904); Kempe, 'How to draw a straight line' (London 1877); Klein, 'Elementargeometrie' (Leipzig 1895); translation by Beman and Smith (Boston 1897); Phillips and Fisher, 'Elements of Geometrie' (New York 1896); Legendre, 'Eléments de géométrie' (Paris 1794); Lindemann, 'Ueber die Zahl π' (Mathematische Annalen, Vol. XX, 1882); Vahlen, 'Abstracte Geometrie' (Leipzig 1905).

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GEOMETRY, History of the Elements of. The history of the science of geometry begins in Greece. It is true that mensuration was developed to a considerable extent at an early period in Egypt, Babylonia and India, and that this work involved the measurement of angles in the astronomical observations of the people of these countries, but the abstract science of form never attained any prominence before the Greek period. In Egypt, for example, the harpedonaptæ (rope stretchers) knew the right-angled triangle whose sides are 3, 4, 5 and stretched their ropes to lay out a right angle in much the same way that a modern surveyor erects a perpendicular by the help of his chain; but there is no evidence that the Egyptians thought of proving the Pythagorean Theorem. Herodotus testifies to the fact that the Egyptians divided the land that was subject to the overflow of the Nile into quadrilaterals, and therefore they must have had some knowledge of elementary surveying. Indeed, long before this time Ahmes (see ALGEBRA, HISTORY OF THE ELEMENTS OF) gave certain rules, partly incorrect, for measuring areas and volumes, in particular an interesting one for the area of the circle, $a=(d-\frac{1}{9}d)^2$. All of this work was, however, very elementary, and the rules were merely the result of unscientific observation.

In Greece the science of geometry may be said to have begun with Thales (q.v.), who was born at Miletus, c. 640 B.C., and who died at Athens in 548. Brought up in contact with the learning that drifted from the East to the shores of the Mediterranean, in his younger days devoted to those commercial pursuits that made Miletus a centre of wealth, he traveled extensively and devoted his later years to philosophy. From Egypt he seems to have taken back to Ionia whatever of primitive geometry was known, and his school at Miletus was devoted to the study of philosophy, astronomy, and the science of form. Thales is supposed to have proved the propositions concerning the equality of vertical angles, the sides opposite the equal angles of a triangle, the determination of a triangle by one side and two angles, the bisection of a circle by a diameter, and the nature of an angle inscribed in a semicircle. His most famous pupil was Pythagoras (q.v.), who was born at Samos c. 580 and died in southern Italy c. 501. A man of great personal magnetism, a mystic, and versed in the lore of the Orient, Pythagoras made his school at Crotona the mathematical centre of his time. Although none of his works is extant, if, indeed, he wrote any, it is known that he proved the famous theorem which bears his name (Euclid I, 47), a proposition already known empirically to the Egyptians and Chinese, and probably to the Hindus, at least for special cases. Pythagoras also gave much attention to the study of proportions and irrational quantities, always from the standpoint of geometry. He also knew the size of the angle of a regular n-gon, and the stellar pentagon was made the badge of his order.

The century following Pythagoras was one of discovery. Among the most noted geometers was Hippocrates of Chios, c. 440 B.C., who must not be confounded with the great physician who may have been the author of a treatise on the mystic number 7. Hippocrates, who had come in contact with the Pythagoreans, wrote the first Greek text-book on mathematics and designated the geometric figures by letters placed at the angles. To him is due the first example of the quadrature of a curvilinear figure, a proposition known as the lunes of Hippocrates. The theorem asserts that if semicircles be described on the three sides of an isosceles right-angled triangle in such way as to form lunes on the two shorter sides, the area of the lunes equals that of the triangle. In his attempt to duplicate the cube he showed that the problem can be solved if two mean proportionals can be found between e and $2e$, where e is the edge. This problem was one of the three famous problems of antiquity, the others being to square the circle and to trisect any given angle. It is now known that these problems, easily solved if the necessary instruments are allowed, cannot be solved merely by the use of an unmarked ruler and a pair of compasses. Contemporary with Hippocrates lived Hippias of Elis, to whom is probably due the quadratrix which Dinostratus afterward studied and named. About the same time Antiphon and Bryson sought the quadrature of the circle by means of inscribed and circumscribed polygons, the number of sides being successively doubled, and with them begin the theories of limits and of exhaustions.

The influence of Plato (429–348 B.C.) on elementary geometry was greater than is usually supposed. He found the science in a disordered state, a mass of unrelated propositions, very likely covering much of plane geometry as found in Euclid. His philosophic mind led him to the attempt to put the science on a more satisfactory foundation by insisting upon accuracy of definition, upon a limited number of postulates (including axioms), and upon definite bounds to plane geometry. As a result, only those figures capable of construction by the help of an unmarked ruler and the compasses are recognized as belonging to the field of elementary geometry. To the school of Plato is also due the analytic method of attack in geometry, including the *reductio ad absurdum*. Although not himself a great discoverer in mathematics, two of Plato's pupils reached high eminence in geometry. Of these the first was Eudoxus, who extended the theory of proportion, founded the doctrine of similar figures, gave much attention to the problem of the golden section, applied the method of exhaustions to the mensuration of solids, and wrote the first text-book upon stereometry. The second was Menæchmus, who, in his attempts to solve the duplication (or Delian) problem, discovered the conic sections. The study of the five regular polyhedra also occupied the attention of Plato's pupils, so much so that they received the name of Platonic bodies.

The influence of Aristotle was directed to the encouragement of the study of the history of geometry and the applications of mathematics. As a result, his followers began to collate the work of the earlier Greeks and to consider its relation to physical problems. Elementary geometry now enters the text-book period and several attempts at works of this character appear in the 4th century, B.C. This movement culminated in the works of Euclid (q.v.), a man of whose personal life we know practically nothing save that he taught and wrote in Alexandria c. 300 B.C. Probably of little originality in the way of mathematical discovery, Euclid had a genius for compilation, and this showed itself in the *Στοιχεῖα* (connected series), or *Elements*, as it was called in later times. This famous work is devoted principally to plane geometry, and it has formed the basis of practically all elementary treatises up to the present time. The natural effect of Euclid's work was to give the impression that the field of elementary plane geometry was exhausted. Mathematicians therefore directed their energies to the applications of geometry, to stereometry and to conics. Archimedes (q.v.), writing at Syracuse c. 240 B.C., opened the great field of mathematical physics and carried the study of elementary geometric solids to its greatest height among the Greeks. To him is also due the limits $3\frac{1}{7}$ and $3\frac{10}{71}$ for π, the study of the spiral that bears his name, and the quadrature of the parabola. Apollonius of Perga (qv.), «the great geometer,» wrote eight books on conics c. 225 B.C., and set a standard which still influences the text-books in analytic geometry. Of the minor geometers who followed Apollonius, two may be mentioned. Nicomedes (c. 180 B.C.), who invented the conchoid, a curve which easily solves the trisection problem, and his contemporary, Diocles, whose cissoid furnishes an easy means for duplicating the cube. Of the later Greek geometers the most noteworthy is Hero of Alexandria (see HERO OF ALEXANDRIA), whose personal history, like that of Euclid, is practically unknown, and to whom it is difficult to assign a date even within a century. His most interesting contribution to elementary geometry is the formula for the area of a triangle in terms of the sides,

$$A = \sqrt{s(s-a)(s-b)(s-c)}.$$

Possibly contemporary with Hero lived Menelaus, whose theorem, known in the Middle Ages as the *Regula sex quantitatum*, has made his name well known. His most important discovery, however, was the projective property of the anharmonic ratio. By this time the age of discovery in geometry had passed in Greece, and the efforts of the Neopythagoreans at Alexandria were productive of little that is remembered. Pappus (c. 300 A.D.), an Alexandrian mathematician and geographer, may be called the last of the Greek geometricians who showed any originality. He suggested the theory of involution of points, restated the projective property discovered by Menelaus, and discovered the theorem (which also bears the name of Guldin) concerning the volume generated by a plane figure revolving about an axis.

The Orientals contributed but little to elementary geometry, their interests being rather directed to algebra (q.v.) and trigonometry (q.v.), with astronomy as the leading application for their advanced mathematics. Brahmagupta, a Hindu, born in 598, generalized the Hero formula, showing that the area of an inscribed quadrilateral is expressed by

$$A = \sqrt{(s-a)(s-b)(s-c)(s-d)},$$

but aside from problems in mensuration, geometry played but little part in India. The Bagdad school of c. 800 was chiefly interested in geometry only as it concerned trigonometry, and its greatest contribution to the science consisted in the preservation of the works of the Greeks. Euclid, for example, was first made known to Christian Europe in the Middle Ages through a translation from the Arabic possibly by Adelhard of Bath, c. 1120.

Among the first books on mathematics to be printed was Euclid's 'Elements' (1482), a fact which made this famous work again a standard. The appearance of this classic had the same effect as in the later centuries of Greek culture, to encourage commentators rather than investigators. In the way of original work, only such minor efforts as the study of stellar polygons and the geometry of a single opening of the compasses characterized the closing decades of the Middle Ages and the opening years of the Renaissance. Not until Kepler (q.v.) suggested the principle of continuity (1604), and Cavalieri set forth the method of indivisibles (1629; published in 1635), and Desargues began the theory of modern geometry (1639), was there any material advance in the subject. When, however, this advance was undertaken it was so vigorous as to lead from elementary geometry to higher fields. In the latter part of the 19th century there was a renaissance of investigation in the elementary domain, leading to an interesting but not very productive study of the geometry of the circle and the triangle, notably in the work of Lemoine and Brocard. The 19th century also saw an exhaustive study of non-Euclidean geometries (q.v.), those based on other postulates than those of Euclid. This study began with the works of Lobachevsky and Bolyai (qq.v.), and has led to very interesting results, hardly to be ranked, however, in the domain of elementary geometry.

Bibliography.— Allman, 'Greek Geometry from Thales to Euclid' (Dublin 1889); Gow, 'History of Greek Mathematics' (Cambridge 1884); Bretschneider, 'Die Geometrie und die Geometer vor Eukleides' (Leipzig 1870); Cajori, Florian, 'History of Mathematics' (New York 1913); Cantor, 'Geschichte der Mathematik' (Leipzig 1880–98, various editions); Chasles, 'Aperçu historique sur l' origine et le developpement des méthodes en géométrie' (Paris 1875); Klein, 'Famous Problems of Elementary Geometry' (trans. by Beman and Smith, Boston 1895); Loria, 'Die hauptsächlichsten Theorien der Geometrie in ihrer früheren and jetzigen Entwickelung' (transl. by Schütte, Leipzig 1888); Tannery, 'La géométrie grecque' (Paris 1887); Heath, T. L., 'The Thirteen Books of Euclid's Elements' (3 vols., Cambridge 1908).

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GEOMETRY, Line-, and Allied Theories. For geometric purposes space may be conceived in an endless variety of ways (see Geometry, Cartesian), i.e., as the manifold of all the geometric entities of *any* given kind contained in it. In particular, it may be viewed as the assemblage (manifold, aggregate, plenum) of its points or of its planes or of its lines. According as one or another of these views be adopted as fundmental, any configuration, as a curve or a surface, will present as fundamental the corresponding aspect, i.e., it will appear as the *locus* (assemblage) of its points or as the *envelope* (assemblage) of its tangent planes or as the *envelope* (assemblage) of its tangent lines. These various views or aspects are not independent. Each involves the others, but they are not co-ordinate: one of them being assumed as fundamental or *primary,* the others appear as derived or *secondary.* Space accordingly admits of various geometric theories distinguished by and taking their names from their primary elements. Line-geometry contemplates space as primary composed of lines, employs the line as fundamental element, and has for its subject-matter the relations and properties of line configurations. Thus the rôle of the right line in this doctrine is quite analogous to that of the point or the plane in the older geometries. The plane, too, has a line-geometry (see Geometry, Modern Analytical), but the line and the point theories of the plane, being analytically identical, are best treated simultaneously as dual aspects of a single doctrine.

The honor of having been the first to make formal and systematic use of the right line as primary element in the geometry of space belongs to Julius Plücker (1801–68), whose 'Neue Geometrie des Raumes gegründet auf die Betrachtung der geraden Linie als Raumelement,' 1868–69, is the first great contribution to the subject. The idea of employing the line as space element had indeed occurred to him at a much earlier date. (Cf. his 'System der Geometrie des Raumes,' 1846). His first memoir on the subject, entitled 'On a New Geometry of Space,' was published in English in 1865 and may be found in Vol 14 of 'The Proceedings of the Royal Society of London' and elsewhere. Certain important line systems, as congruences and complexes (names given by Plücker), had indeed been previously studied to some extent by others. The notion of congruences of lines naturally first presented itself in geometric researches in optics, and in fact the first appearance of the concept of the line complex seems to be that found in the 'Traité d'Optique' of the physicist, Étienne Louis Malus (1775–1812). The point-plane and line-line correlations or null-systems established by the linear complex were considered in 1827 by the Italian geometrician Giorgini ('Memorie dei XL,' Vol. 20), and in 1833 by Moebius in a memoir entitled 'Über eine besondere Art dualer Verhältnisse zwischen Figuren im Raume' ('Crelle's Journal,' Vol. IX–X). Nevertheless the invention of the line geometry of space is, as said, to be properly ascribed to Plücker. His work in this field is the beginning of a great epoch in the science of analytical geometry. The undying influence of that work is due neither to its content nor, strictly speaking, to its method, important as these are. It is rather due to its spirit, which is the spirit of freedom, emancipating alike from traditional concepts and traditional modes of procedure. Since Plücker's time the science begun by him has been greatly refined and vastly extended, and out of it have come great and growing kindred doctrines, as the sphere and the circle geometries of space, and allied theories in spaces of higher dimensionality. The following paragraphs present a brief account of the elements of some of these theories, especially of line geometry, together with some indications of further developments and references to the corresponding literature.

Line Co-ordinates.— In Cartesian co-ordinates (see GEOMETRY, CARTESIAN) the line is determined by any pair of its projecting planes, e.g., by the pair $x=rz+\rho$, $y=sz+\sigma$; conversely, any such pair determines a line. Accordingly the position of the line depends upon four independent quantities or *co-ordinates*, r, s, σ, ρ; the line has four degrees of freedom, space contains a fourfold infinity, ∞^4, of lines; in lines it is 4-dimensional: a being who thought in lines as «naturally» as man thinks in points would regard (our) space as having four instead of three dimensions. Linear transformation of Cartesian co-ordinates converts the line co-ordinates r, s, σ, ρ, into the co-ordinates r', s', σ', ρ', (of the same line), where these are fractions whose terms are linear functions of r, s, σ, ρ, and $r\sigma-s\rho'$; and, accordingly, an equation of degree n in r, s, σ, ρ is converted into one of degree $2n$ in those quantities. In order that the new and the old equations should be of the same degree in the old co-ordinates, Plücker introduced a fifth co-ordinate η, where $\eta=r\sigma-s\rho$. There are numerous other systems of line co-ordinates, and in his above-cited first paper Plücker himself presents no less than eight distinct systems. Of all the systems those that are *homogeneous* are at once the most artistic and convenient. These naturally present themselves as follows: If x_i and ξ_i $(i=1, 2, 3, 4)$ denote respectively the homogeneous co-ordinates (see GEOMETRY, MODERN ANALYTICAL) of a point and a plane referred to a fundamental tetraedron, then the equation $\xi_1x_1+\xi_2x_2+\xi_3x_3+\xi_4x_4=0$, or $\Sigma\xi_ix_i=0$, will serve to represent the plane ξ_i (as locus of points) or the point x_i (as envelope of planes). It is at the same time the condition that the point x_i and the plane ξ_i shall be united in position, each containing the other. The line determined by two planes ξ_i and η_i is represented by the pair of equations $\Sigma\xi_ix_i=0$ $\Sigma\eta_ix_i=0$. It is equally determined by any two planes of the axial pencil $\Sigma(\xi_i+\lambda\eta_i)x_i=0$. Of these the simplest are the four of which each contains a vertex of the tetraedron of reference. Their equations are

$$\begin{aligned}
* \quad +q_{12}x_2+q_{13}x_3+q_{14}x_4&=0,\\
q_{21}x_1+\quad * \quad +q_{23}x_3+q_{24}x_4&=0,\\
q_{31}x_1+q_{32}x_2+\quad * \quad +q_{34}x_4&=0,\\
q_{41}x_1+q_{42}x_2+q_{43}x_3+\quad * \quad&=0,
\end{aligned}$$

where $\rho q_{jk}=\xi_j\eta_k-\xi_k\eta_j$, ρ being a proportionality factor; e.g., $\rho q_{12}=\xi_1\eta_2-\xi_2\eta_1$. As $x_{jk}=-q_{kj}$, there are but six numerically distinct coefficients q. These are connected by the quadratic identity $q_{12}q_{34}+q_{13}q_{42}+q_{14}q_{23}=0$; as, moreover, only their ratios are essential, the six q's are equivalent to but four independents. Accordingly the q's may be, and for the sake of symmetry are, adopted as *six homogeneous co-ordinates of the line regarded as the axis (envelope) of a pencil of planes.*

The line has another aspect; it may be viewed as locus of its points, determined by any pair of them as x_i and y_i. Thus considered, it is represented by the pair of point equations $\Sigma x_i\xi_i=0$, $\Sigma y_i\xi_i=0$. The line is equally determined by any two points of the range $\Sigma(x_i+\lambda y_i)\xi_i=0$ and in particular by any two of the four points in which the line pierces the faces (planes) of the fundamental tetraedron. Of these points the equations are

$$\begin{aligned}
* \quad +p_{12}\xi_2+p_{13}\xi_3+p_{14}\xi_4&=0,\\
p_{21}\xi_1+\quad * \quad +p_{23}\xi_3+p_{24}\xi_4&=0,\\
p_{31}\xi_1+p_{32}\xi_2+\quad * \quad +p_{34}\xi_4&=0,\\
p_{41}\xi_1+p_{42}\xi_2+p_{43}\xi_3+\quad * \quad&=0,
\end{aligned}$$

where $\sigma p_{kj}=x_jy_k-x_ky_j$. The six p's satisfy an identity like that of the q's, the ratios of the p's are alone important, and, again with a view to symmetry, the p's are chosen as the *six homogeneous co-ordinates of the line conceived as a locus (range) of points.*

It is readily found that the line p_{jk} and the line q_{jk} are one and the same when and only when $p_{12}:q_{34}=p_{13}:q_{42}=p_{14}:q_{23}=p_{34}:q_{12}=p_{42}:q_{13}=p_{23}:q_{14}$. Accordingly, disregarding both the locus and envelope aspects of the line, we may employ for its co-ordinates any six quantities r_{jk} which, ρ and σ being proportionality factors, satisfy the relations: $r_{12}=\rho q_{12}=\sigma p_{34}$, $r_{13}=\rho q_{13}=\sigma p_{42}$, $r_{14}=\rho q_{14}=\sigma p_{23}$, $r_{34}=\rho q_{34}=\sigma p_{12}$, $r_{42}=\rho q_{42}=\sigma p_{13}$, $r_{23}=\rho q_{23}=\sigma p_{14}$. The identity connecting the r's may be written (after Koenigs) $\omega(r)=2(r_{12}r_{34}+r_{13}r_{42}+r_{14}r_{23})=0$.

Passing from homogeneous to Cartesian point co-ordinates, i.e., from a finite tetraedron to an infinite one having three of its faces mutually perpendicular and for the fourth the plane at ∞, there result the six homogeneous line co-ordinates employed by Plücker. The transition is effected by substituting $x', y', z', 1$ respectively for x_1, x_2, x_3, x_4, and $x'', y'', z'', 1$ for y_1, y_2, y_3, y_4; the Plücker co-ordinates accordingly are:

$$p_{12}=x'y''-x''y',\ p_{13}=x'z''-x''z',\ p_{23}=y'z''-y''z',$$
$$p_{14}=x'-x'',\quad p_{42}=y''-y',\quad p_{34}=z'-z''.$$

If we replace x'', . . . by $x+dx'$, . . . i.e., if we regard the line as determined by consecutive (neighboring, «infinitely near») points, the Plücker co-ordinates assume the form adopted by Sophus Lie. The primes being omitted, the Lie line co-ordinates are: $p_{12}=xdy-ydx$, $p_{13}=xdz-zdx$, $p_{23}=ydz-zdy$, $p_{14}=-dx$, $p_{42}=dy$, $p_{34}=-dz$.

The general co-ordinates r_{jk} admit of further generalization. They may be replaced by linear functions of them; i.e., if $r_{jk}=C_{jk,1}v_1+C_{jk,2}v_2+\ldots+C_{jk,6}v_6$, where the determinant of the C's does not vanish, the six variables v_i may be employed as line co-ordinates. The v's satisfy a quadratic identity $\xi(v)=0$, into which $\omega(r)=0$ is converted by the foregoing transformation. A simple special case of this transformation yields an elegant system of line co-ordinates introduced by Felix Klein. Replacing the v's by x's, the special transformation is: $x_1=r_{12}+r_{34}$, $ix_2=r_{12}-r_{34}$; $x_3=r_{13}+r_{42}$, $ix_4=r_{13}-r_{42}$; $x_5=r_{14}+r_{23}$, $ix_6=r_{14}-r_{23}$; where $i=\sqrt{-1}$. The Kleinian line co-ordinates are

x_j ($j = 1, \ldots, 6$). The identity connecting them is $\Sigma x_j^2 = 0$.

Condition of Intersection of Lines.— The two lines may be conceived as loci, or as axes, or one as a locus and the other as an axis. In the first case, suppose the lines are determined respectively by the point pairs (x_i, y_i) (x'_i, y'_i). The lines p and p' will intersect when and only when the four points lie in a plane, for which the necessary and sufficient condition is

$$\begin{vmatrix} x_1 & x_2 & x_3 & x_4 \\ y_1 & y_2 & y_3 & y_4 \\ x_1' & x_2' & x_3' & x_4' \\ y_1' & y_2' & y_3' & y_4' \end{vmatrix} = 0,$$

which on expansion yields $p_{12}p'_{34} + p_{13}p'_{42} + p_{14}p'_{23} + p_{34}p'_{12} + p_{42}p'_{13} + p_{23}p'_{14} = 0$. Of this condition the first member is

$$\frac{1}{2}\left[\frac{\partial\omega(p)}{\partial p_{12}}p'_{12} + \ldots + \frac{\partial\omega(p)}{\partial p_{42}}p'_{42}\right]$$
$$\equiv \frac{1}{2}\left[\frac{\partial\omega(p')}{\partial p'_{12}}p_{12} + \ldots + \frac{\partial\omega(p')}{\partial p'_{42}}p_{42}\right].$$

Denoting this *polar* form by $\omega(p, p')$, the condition that the two lines (loci, point ranges) p and p' shall have a common point is $\omega(p,p') = 0$. In like manner, the condition that the lines (envelopes, axial pencils of planes) q and q' shall have a common plane is $\omega(q,q') = 0$. If one of the lines be regarded as a locus, the other as an envelope, the condition of intersection is $\Sigma p_{jk}q'_{jk} = 0$ or $\Sigma q_{jk}p'_{jk} = 0$. Disregarding the aspects of the lines r and r', the condition is $\omega(r,r') = 0$. The preceding transformation from r's to v's converts $\omega(r, r')$ into $\xi(v, v')$,

where $2\,\xi(v, v') = \frac{\partial\xi}{\partial v_1}v_1' + \ldots + \frac{\partial\xi}{\partial v_6}v_6'$.

Hence the condition that the lines v, v' shall intersect is $\xi(v, v') = 0$. In Klein co-ordinates, the condition for the intersection of the lines x and x' is $\Sigma x_j x'_j = 0$ ($j = 1, \ldots 6$).

Pencils and Hyperpencils.— Let v_i' and v_i'' be any two intersecting lines. These determine a flat pencil, viz., that whose vertex is the common point of v' and v'' and whose lines lie in the plane of v' and v''. All and only the co-ordinates of the lines of the pencil are given by the formula $v_i = \lambda v_i' + \mu v_i''$. For, first, $\xi(v) = \xi(v')\lambda^2 + 2\xi(v', v'')\lambda\mu + \xi(v'')\mu^2$, and, by hypothesis, $\xi(v') = 0$, $\xi(v'') = 0$, $\xi(v', v'') = 0$; hence $\xi(v) = 0$, and v_i represents a line for all values of the parameters λ and μ. Secondly, if v_i''' be *any* line cutting v' and v'', $\xi(v', v''') = 0$, $\xi(v'', v''') = 0$; hence $\xi(v, v''') = 0$, for $\xi(v, v''') = \lambda\xi(v', v''') + \mu\xi(v'', v''')$; therefore the lines v_i belong to the pencil. Thirdly, these are *all* of the lines of the pencil, for it is easily proved that the ratio, $\lambda:\mu$ can be determined so that the corresponding v_i shall cut *any* given line not contained in the plane of the pencil.

Koenigs has suggested the name hyperpencil (*hyperfaisceau*) to denote alike the totality of lines of a plane and the totality (sheaf, bundle) of lines through a point. A hyperpencil is determined by any three lines (not in a same pencil) of which each intersects the other two. If three such lines be v_i', v_i'', v_i''', then all and only the co-ordinates of the hyperpencil are given by the formula $v_i = \lambda v_i' + \mu v_i'' + \nu v_i'''$, λ, μ, ν being parameter. The hyperpencil will be a sheaf or a plane of lines according as the given lines determine but one point of three points.

Line Systems in General.— Just as, for example, in ordinary analytical geometry, we study systems (loci) of points represented by equations in point co-ordinates, so in the present subject we are concerned with line systems represented by equations in line co-ordinates. The line, we have seen, depends on four independent variables, co-ordinates or *parameters*. The totality of lines in space may be called the 4-parameter system; it contains ∞^4 lines, a line in it has four degrees of freedom, one degree for each of the free (unconditioned) parameters or co-ordinates. One condition on the four parameters renders them equivalent to but three independent ones; hence the lines represented by one equation constitute a 3-parameter system, called by Plücker a line *complex*. A complex contains ∞^3 lines, a line in a complex has but three degrees of freedom. A 2-parameter system or *congruence* (Plücker), containing ∞ lines, allowing the line two degrees of freedom, is defined by a pair of equations. A triplet of equations represents a 1-parameter system, a ruled surface, or, better, a *line series* (*Série réglée* Koenigs); it contains ∞^1 lines; in such a system the line has but one degree of freedom. Finally, a 0-parameter system, defined by four simultaneous equations, contains but a *finite* number of lines. In order, then, that five or more equations should represent a common system of lines, it is necessary that their coefficients satisfy some condition or conditions.

The Linear Complex.— The complex defined by an equation of degree n is said to be of nth degree. If $n = 1$, the complex is called *linear*. The general equation of the linear complex is $c_1v_1 + c_2v_2 + \ldots + c_6v_6 = 0$, or briefly, $\Sigma c_jv_j = 0$, where $\xi(v) = 0$. How are the lines distributed? Let $v_i = \lambda v_i' + \mu v_i'' + \nu v_i'''$ be an arbitrary hyperpencil. In order that a line of the hyperpencil shall belong to the complex, it is necessary and sufficient that $\Sigma c_i(\lambda v_i' + \mu v_i'' + \nu v_i''') = 0$, a single linear condition of the (two independent) ratio $\lambda:\mu:\nu$. Hence a single infinity of the lines of the hyperpencil belong to the complex. For if $u_i' = \lambda_1 v_i + \mu_1 v_i'' + \nu_1 v_i'''$ and $u_i'' = \lambda_2 v_i'' + \mu_2 v_i'' + \nu_2 v_i'''$ be any two of them, then plainly all lines of the pencil (u', u'') belong to the complex. On the other hand, unless the entire hyperpencil belongs to the complex, no other line u''' does so belong, for if it did, then every pencil determined by u''' and the lines of (u', u''), i.e., all lines of the hyperpencil, would belong to the complex. Hence the proposition: *The lines of a linear complex are so distributed that every hyperpencil in space contains a pencil of lines (and no other line) belonging to the complex, unless the hyperpencil itself is entirely contained in the complex.* These pencils are called the pencils of the complex. The proposition admits of various equivalent statements of which one of the most illuminating is: *Given a linear complex, in general, each point of space is the vertex of a pencil of lines of the complex and contains no other line of it; in each plane in general there is a pencil of lines (but no other line) of the complex.* In the former case the plane containing the pencil of the point is called the *polar* (plane) of the point; in the latter, the vertex of the pencil in the plane is called the *pole* (point) of the plane. Thus a linear complex serves to pair the points and planes of space as poles and polars, any pole and its polar being united in position. If a point P and a plane π be united in position, the pole P' of π and the polar π' of P are also united. Not only, however, are points and planes paired, but lines are paired with lines. The line common to two poles corresponds to the line common to their polars. Two such corresponding lines are called *conjugates* with respect to the complex. To a range of points (poles) corresponds an axal pencil of planes (polars), the base of the range and the axis of the pencil being conjugate lines. A line cutting two conjugates belongs to the complex, and all lines of the complex that cut a given line cut its conjugate also. If two lines intersect, so do their conjugates. Every line of the complex is its own conjugate, and conversely. If a point moves along a line of the complex, the polar plane turns about the same line. This is a special case of the proposition that if a point glides along any line, the polar plane rotates about the conjugate line. Hence, if P_1, P_2, P_3, P_4, be any four positions of the moving point and if π_1, π_2, π_3, π_4 are the corresponding planes, then the anharmonic ratios are equal, i.e., $(P_1P_2P_3P_4)=(\pi_1\pi_2\pi_3\pi_4)$. In general: if C planes, the polars, conjugates and poles (with respect to a given complex) constitute a configuration C'. C and C' are called *reciprocal* configurations. The points, lines and planes of either correspond uniquely and respectively to the planes, lines and points of the other. In particular, if C is a polyedron, so is C'. The edges of either are conjugates of the edges of the other; the vertices and faces of either are respectively the poles and polars of the faces and vertices of the other. The vertices of either lie in the (polar) faces of the other.

Invariant of Complex, Special Complex, Directrix.— The condition,

$$2\xi(v,v')=\frac{\delta\xi}{\delta v_1'}v_1+\ldots+\frac{\delta\xi}{\delta v_6'}v_6=0,$$

that the line v shall intersect the line v', represents a *special* complex, viz., that of which all the lines cut a given line v', called the *directrix* of the complex. The complex $\Sigma c_jv_j=0$ is, then, special when and only when

$$\frac{\partial\xi}{\partial v_1'}:\frac{\partial\xi}{\partial v_2'}:\ldots:\frac{\partial\xi}{\partial v_6'}=c_1:c_2:\ldots:c_6.$$

These equations yield the values of (the ratios of) the $v_j\delta$ in terms of the c_j. Substituting those values in $\xi(v\delta)$, there results a homogeneous quadratic $\Omega(c)$, so that $\xi(v\delta)=\Omega(c)$. Hence $\Omega(c)=0$ when and only when $\xi(v\delta)=0$; hence the necessary and sufficient condition that $\Sigma c_jv_j=0$ shall represent a special complex is that $\Omega(c)=0$. In such case the co-ordinates of the directrix are the co-efficients c_j. The expression $\Omega(c)$ has been named by Klein the *invariant of the complex* $\Sigma c_jv_j=0$. The complex is, therefore, special or non-special according as its invariant vanishes or does not. If $\xi(v)$ be reduced to the Plücker type $\omega(v)=2(v_1v_4+v_2v_5+v_3v_6)$, the invariant assumes the form $\Omega(c)=2(c_1c_4+c_2c_5+c_3c_6)$. In case the above-mentioned Klein co-ordinates are employed, the form of the invariant is $\Omega(c)=\Sigma c_j^2$ ($j=1,\ldots,6$).

Pencils of Complexes, and Line Congruences.— The system of lines common to two complexes is named a line *congruence*. It is plain that the lines of the congruence determined by two complexes $\Sigma c_jv_j=0$ and $\Sigma c'_jv_j=0$ are common to the complexes of the pencil $\lambda\Sigma c_jv_j+\mu\Sigma c'_jv_j=\Sigma(\lambda c_j+\mu c'_j)v_j=0$ of complexes and that the congruence is equally determined by any two complexes of the pencil. Does the pencil include special complexes? If so, how many? The condition, $\Omega(\lambda c=\mu c')=0$, for special complexes, is quadratic in the ratio $\lambda:\mu$ of the parameters, and hence yields two values for that ratio, which may be real and distinct, real and equal, or imaginary. Accordingly, every pencil of complexes contains two and but two special complexes, real and distinct, coincident or imaginary. The directrices of the special complexes are cut by all and only the lines of the congruence and are called the *directrices of the congruence*. Conversely, the assemblage of lines that intersect two given lines is a congruence. Hence a congruence is often defined to be the totality of lines intersecting two fixed lines. The directrices of a congruence are conjugate lines with respect to every complex of the corresponding pencil of complexes. In case the discriminant of the foregoing quadratic is zero, the directrices coincide. The (double) directrix is a line of the congruence. That discriminant is called the *invariant of the congruence*. The vanishing of the invariant signifies coincidence of the two special complexes and of their directrices. It may happen that the quadratic is identically zero. Then all complexes of the pencil are special and the directrices constitute a pencil of lines.

Angle of Complexes; Involution.— Let a, b, c, d be any four values of the parameter $\lambda:\mu$ of the above pencil of complexes. The anharmonic ratio $(abcd)$ may be called the anharmonic ratio of the four corresponding complexes. If l be a line of the congruence, π a plane of l, and P_1, P_2, P_3, P_4 be the poles of π as to the complexes a, b, c, d respectively, then the anharmonic ratio $(P_1P_2P_3P_4)=(abcd)$. Also, if π_1, π_2, π_3, π_4 are the polar planes of a point P of l with respect to the four complexes, then $(\pi_1\pi_2\pi_3\pi_4)=(abcd)$. Hence $(\pi_1\pi_2\pi_3\pi_4)=(P_1P_2P_3P_4)$, and these equal ratios remain constant as π rotates about (P glides along) l and also as l varies its position in the congruence. We may suppose that b and d correspond to the special complexes of the pencil and denote by F and F' the points common to l and the directrices and by ϕ and ϕ' the planes determined by l and the directrices. Then $(P_1FP_2F')=(abcd)=(\pi_1\phi\pi_2\phi')$. Denote this anharmonic ratio by r. The corresponding angle, $A=(\log r):2\sqrt{-1}$, has been named by Klein the angle of the *complexes* a and c. If a and b be so taken (and that is possible) that $A=90°$, whence $r=-1$, then the two corresponding complexes are said to be orthogonal or *in involution*. The geometric significance of this relationship is that, when and only when it subsists between two complexes, each contains the conjugates of its lines with respect to the other. This subject of involution is intimately connected with the general doctrine of linear systems of linear complexes, but it cannot be further pursued here.

Hyperpencil of Complexes.— We may thus term the system $\Sigma(\lambda c_j + \mu c'_j + \nu c_j'')v_j = 0$ determined by three independent complexes. $\Sigma c_j v_j = 0$, $\Sigma c'_j v_j = 0$, $\Sigma c_j'' v_j = 0$. The name, system of three terms, is often employed instead of hyperpencil. The ∞^1 lines common to the three fundamental complexes are obviously common to all complexes of the hyperpencil. They constitute a ruled surface of second order. That the surface is of second order appears from the fact that the number of points in which it is pierced by a line u_j, i.e., the number of solutions of the equations $\Sigma c_j v_j = \Sigma c'_j v_j = \Sigma c_j'' v_j = \xi(v) = \xi(v, u)$, is two. The surface is in general an *hyperboloid of one sheet;* in special case, a *hyperbolic paraboloid.* The lines constitute, however, but one system of generators. What of the other system? To answer, observe that the condition, $\Omega(\lambda c + \mu c' + \nu c'') = 0$, that the hyperpencil shall contain special complexes, yields ∞^1 pairs of values of the (two independent) ratios $\lambda : \mu : \nu$. Hence the hyperpencil includes ∞^1 special complexes. The directrices of these constitute the second system of generators. These last are not lines common to the hyperpencil, on which account it seems better (after Koenigs) to call the lines common to the hyperpencil not a ruled surface, but a demi-quadric or series of lines.

Complex of Higher Degree.— An equation $f_n(v) = 0$ of degree n in line co-ordinates v_j defines a complex of degree n. Any line-pencil of space contains n lines of such a complex, so that the degree of a complex may be geometrically defined to be the number of lines common to the complex and an arbitrary pencil. The lines common to a complex of nth degree and a hyperpencil constitute a cone of order n if the hyperpencil is a sheaf, and envelope a plane curve of class n if the hyperpencil is a plane of lines. The cone is called a cone of the complex; and a curve, a curve of the complex. Every point of space is the vertex of such a cone, and every plane contains such a curve. As above seen, if $n = 1$, the cone degenerates into a plane (pencil of lines) and the curve degrades into a point (pencil of lines enveloping it). The 'Neue Geometrie' of Plücker is chiefly devoted to the quadratic complex, $n = 2$, and many of its cardinal properties are there discovered. For the literature of the subject, including the general doctrine of complexes, the reader is referred to the works above cited and to the bibliography below. We give next a very brief account of certain closely.

Allied Theories

the study of whose connections and general comparative anatomy is one of the most instructive and fascinating chapters in the development of modern geometry.

Plane Geometry of the Point in Four-space.— Space that is 4-dimensional in points is also 4-dimensional in lineoids (ordinary 3-dimensional spaces). It is 6-dimensional in lines and also in planes. Hence in 4-space the point and the lineoid are dual (reciprocal) elements, and so the the plane and the line. The lineoid contains ∞^4 lines; the point, ∞^4 planes. The lineoid contains ∞^3 points and as many planes; the point contains ∞^3 lineoids and as many lines. Hence in 4-space, the point, plane and line geometries of the lineoid are respectively dual to the lineoid, line and plane theories of the point. Between any two of these pairs of reciprocal geometries there is a fact-to-fact correspondence, and the algebras of any such pair are identical. The emphasis here falls upon the fact that the line geometry of the lineoid (i.e., ordinary line geometry) is precisely the same analytically as the geometry of the 4-space point regarded as the assemblage of its (generating) planes. For an introductory detailed account of the elements of the latter theory, and of the mentioned parallelism, consult 'The Plane Geometry of the Point in Point-space of Four Dimensions' ('American Jour. of Math.,' Vol. XXV).

Geometry of (Ordinary) Space in Pentaspherical Co-ordinates.— The square of the tangent-distance from a point to a sphere is named the *power of the point with respect to the sphere.* Denote by x_k ($k = 1, \ldots, 5$) the powers of a point with respect to five fixed mutually orthogonal spheres. The x_k satisfy the identity $\Sigma x_k^2 = 0$. To any set of values of their ratios there corresponds a definite point and conversely. The quantities λx_k are called *pentaspherical point co-ordinates.* Their discovery and introduction into geometry are mainly ascribable to Gaston Darboux (cf. his memoir 'Sur une classe remarquable de courbes et de surfaces algébraiques,' 1873), but in part also to Felix Klein and Sophus Lie (cf. 'Mathematische Annalen,' Vol. V). In these co-ordinates the equation of a sphere is linear, viz., $\Sigma m_k x_k = 0$ ($k = 1, \ldots 5$); conversely, every such equation represents a sphere. The radius is $\rho = (\sqrt{\Sigma m_k^2}) : \Sigma(m_k \div R_k)$, where the R_k are the radii of the fundamental spheres. Certain analytic correspondences between line geometry (in Klien co-ordinates) and point geometry in pentaspherical point co-ordinates are immediately obvious. For example: in the former $\Sigma x_j^2 = 0$ ($j = 1, \ldots, 6$) is the identity satisfied by the line co-ordinates x_j; in the latter, $\Sigma x_k^2 = 0$ ($k = 1, \ldots, 5$) is the identity connecting the pentaspherical point co-ordinates; in the former, $\Sigma m_j x_j = 0$ represents a linear complex; in the latter, $\Sigma m_k x_k = 0$ represents a sphere; in the former, $\Sigma m_j^2 = 0$ means that the complex is special; in the latter, $\Sigma m_k^2 = 0$ signifies that the sphere is a point; and so on and on.

Sphere Geometry of Space.— In this doctrine, due to Sophus Lie, the sphere is taken as primary element. To pick out a sphere from among all the spheres of space, it is necessary and sufficient to know four independent things about it, as the (three) co-ordinates of its centre and the length of its radius. Hence the sphere like the line, has four independent co-ordinates, it has four degrees of freedom, and sphere geometry, like line geometry, is 4-dimensional. We have seen that every equation $\Sigma m_k x_k = 0$ in pentaspherical point co-ordinates x_k represents a sphere, and conversely; hence the five coefficients m_k may be taken as *homogeneous sphere co-ordinates,* their ratios being equivalent to four *independents.* The system may be rendered homologous to that of the six line co-ordinates by introducing a sixth sphere co-ordinate m_6 by the definition, $im_6 \equiv \sqrt{\Sigma m_k^2}$, where $i = \sqrt{-1}$ and ($k = 1, \ldots, 5$). The six homogeneous, sphere co-ordinates m_j ($j = 1, \ldots, 6$) satisfy the quadratic identity

$\Sigma m_j = 0$, identical in form with that connecting the Klien line co-ordinates. The condition that the spheres m and m' shall be tangent is $\Sigma m_j m_j' = 0$, which is precisely like the condition, $\Sigma x_j x_j' = 0$, that the lines x and x' shall intersect, a most interesting and fruitful principle of correspondence discovered by Lie in his brilliant memoir, 'Über Complexe, in besondere Linienund Kugel-Complexe, mit Anwandung auf die Theorie partieller Differentialgleichungen' ('Mathematische Annalen,' Vol. V, 1871).

Circle Geometry of Space.— In this beautiful and growing theory, principally due to the French mathematicians E. Cosserat, C. Stéphanos, and G. Koenigs, the circle is employed as primary or generating element of space. In this element, space is 6-dimensional, like point 4-space in lines or planes. A circle is determined as the intersection of two spheres, as $\Sigma m_j x_j = 0$, $\Sigma m_j' x_j = 0$ $(j = 1, \ldots, 5)$. It is equally determined by any two spheres of the pencil or range, $\Sigma(m_j + \lambda m_j')x_j = 0$, of spheres containing it, and, in particular, by any two of the included five of which each is orthogonal to one of the fundamental spheres. The equations of those special spheres correspond to the five λ-values that render the coefficients $m_j + \lambda m_j' = 0$ in succession. For the sake of symmetry, the ten coefficients $p_{ik} = (m_k' - m_k m_i'$ are taken as homogeneous co-ordinates of the circle. That the ten are equivalent to the necessary and sufficient number six of independents is seen in the facts that only their rations are essential and that they satisfy five (equivalent to three independent) quadratic identities of the form $\omega_a(p) = 2(p\beta\gamma p\delta\epsilon + p\beta\delta p\epsilon\gamma + p\beta\epsilon p\gamma\delta) = 0$. The circle geometry of space is not parallel to the line geometry of ordinary space, but it is parallel, in a fact-to-fact fashion, to the line and the plane geometries of point 4-space.

Theory of Circles Orthogonal to Sphere. — Two spheres m_k and m_k' $(k=1, \ldots, 5)$ are orthogonal when and only when $\Sigma m_k m_k' = 0$; hence there are ∞^3 spheres orthogonal to a given sphere. A circle is orthogonal to a sphere when and only when any two (and hence all) of its generating spheres are orthogonal to the sphere. There are, accordingly, ∞^4 circles orthogonal to a given sphere. A one-to-one correlation subsists between such circles and the lines of space. If, in the assemblage of spheres orthogonal to a given sphere, four mutually orthogonal spheres be taken as fundamental or co-ordinate sphere any equation $\Sigma m_k x_k = 0$ $(k = 1, \cdot \ldots, 4)$ will represent a sphere of the assemblage, and conversely. Hence a pair of such equations will define a circle orthogonal to the fixed sphere, and conversely. It is immediately plain that the co-ordinates of the circle regarded as element of the assemblage of circles orthogonal to a given sphere are analytically precisely the same as the line co-ordinates of space. Hence the geometry of such a circle assemblage is analytically identical with line geometry. The first chapters of such a circle geometry are found in 'The Geometry of Circles Orthogonal to a Given Sphere,' by C. S. Forbes (Columbia University Press, 1904).

Bibliography.— The literature of line geometry and allied theories is extensive and is rapidly increasing. In addition to the foregoing citations, may be mentioned the following works, which together with further citations contained in them constitute a complete bibliography of the subject: Cayley 'On the Six Co-ordinates of a Line' (Collected Papers, Vol. VII); Cosserat, 'Sur le cercle considéré comme élément générateur de l'espace' (see preceding reference); Jessop, 'Treatise on the Line Complex'; 'Encyklopädie der Mathematischen Wissenschaften' (Vol. III); Klein, 'Einleitung in die höhere Geometrie' and various memoirs by him in Vol. V and subsequent volumes of *Mathematische Annalen*; Koenigs, 'La géométrie réglée et ses applications' (*Annales de la Faculté des Sciences de Toulouse*, Vols. III *et seq.*); Loria, 'Il passato ed il presente delle principali teorie geometriche'; E. Pascal, 'Repertorio di mathematiche superiori'; Sturm, 'Die Gebilde ersten und zweiten Grades der Liniengeometrie,' a synthetic treatise; Pasch, 'Zur Theorie der linearen Complexe' (Crelle's Journal, Vol. 75); Study, 'Geometrie der Dynamen.'

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GEOMETRY, Modern Analytical. No preliminary statement of the significance of this title could be quite satisfactory to any, much less to all. An adequate sense of its meaning can be gained only by study of the subject itself; and in this case, as in that of most other doctrines, it is better for the reader to end, than for the writer to begin, by an attempt at definition. Logically and historically modern analytical geometry is the outgrowth of Cartesian geometry (q.v.). The former, while in a sense it includes the latter as a special case, avails itself of many principles, processes, and points of view unknown to the older doctrine. It is the aim of this article to give a brief account of some of the modern notions and methods, with particular reference to the geometry of the plane. For further information the reader may see the articles: GEOMETRY, CARTESIAN; CURVES, HIGHER PLANE; GEOMETRY, LINE AND ALLIED THEORIES; CURVES OF DOUBLE CURVATURE; SURFACES, THEORY OF; HYPERSPACES. As to related matter of pure geometry, see the articles: GEOMETRY, ELEMENTARY; GEOMETRY, PURE PROJECTIVE; and GEOMETRY, NON-EUCLIDEAN. In the following, acquaintance with the elements of ordinary (Cartesian) geometry will be presupposed.

One-dimensional Spaces: Range and Pencil; Elements at Infinity.— Any geometric entity in a given space may be taken as generating element of the space, which is then regarded as the assemblage of all the elements of the chosen kind. A space being assumed, its dimensionality depends upon the choice of generating element and is the number of independent parameters, or co-ordinates, necessary for the determination of the element as in some sense a continuous function of them. This is what is meant, to take the most familiar examples, by saying that any surface, say a plane, is two-dimensional, and that ordinary space is three-dimensional, in points. Any space being assumed, it is always possible to select as element an infinity of different kinds of entities for any one (kind) of which the space shall have prescribed dimensionality k. Thus the plane is two-dimensional in lines (see below), its dimensionality is 3 in circles, 4 in parabolas, 5 in conics, . . . , while the dimensionality of ordinary space is 3 in planes, 4 in lines or in spheres (see LINE GEOMETRY), 6 in circles, etc. A plane curve may in general be conceived either as a locus, assemblage of its points, or as an envelope, assemblage of its (tangent) lines. In either view the curve appears as a one-dimensional space, of points in the former view, of lines in the latter. Of such one-fold spaces, the simplest, and hence in a sense the most important, varieties are the range and the pencil, the former being the straight line regarded as the locus or assemblage of its points, and the later being the point regarded as the envelope or assemblage of its lines (the lines through it). Commonly the line is called the *base* of its range, and the point is called the vertix of its pencil. In passing it may be pointed out that if a pair or triplet, . . . of points (lines) be taken as element of the line (point), the line (point) appears as a space of 2, or 3, . . . dimensions in such pairs, triplets. . . .

Let V and b respectively be any pencil and range. The plane being supposed Euclidean in respect to parallels (see GEOMETRY, NON-EUCLIDEAN), V contains a single line parallel

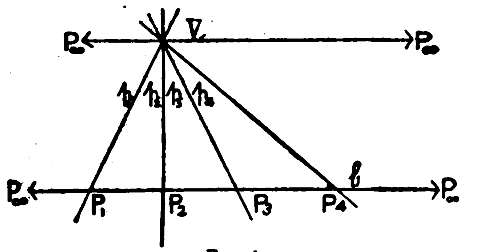

FIG. 1.

to b. Plainly, through any (finite) point of b there passes one and but one line of V; and, conversely, every line of V, except the mentioned parallel, passes through a (finite) point of b. In order to avoid the exception and render the one-to-one correspondence complete, a convention is made, namely, that every range shall be regarded as having one and but one *infinitely distant* point P_∞, called the *infinite point* of the range, and that the infinite point of any range is identical with that of any parallel range. Accordingly any infinite point of the plane is the vertex of a pencil of parallel lines, and the system of lines parallel to a given one constitute a pencil vertexed at ∞. The notion of parallel lines meeting at ∞ had occurred to Kepler, but the systematic introduction of the convention was made by Gerard Desargues (1593–1662), chief among the founders of modern pure geometry. From that convention it readily follows, by the theory of similar triangles, that the natural assumption concerning the (infinite) distances from any two finite points of a range to its infinite point is that they are equal. The locus of the infinite points of the plane is a straight line, called the *infinite line* of the plane. As for space, the locus of its infinite points is a plane. In general the locus of the infinite points in a point-space of n dimensions is a point-space of $n-1$ dimensions. If a range rotate (in a plane) about one of its finite points, every other point of the range will generate a circle; the path of the infinite point being a straight line, the latter appears as a circle of infinite radius; a perfectly natural phenomenon, for the curveture, $1:r$, of a circle of radius r, vanishes for $r=\infty$.

Non-homogeneous and Homogeneous Co-ordinates of Point and Line of Range and Pencil.— In a range choose a point O for *origin* of distances. Denote by d the distance from O of an arbitrary point P of the range. Let $x=\rho d$, where the factor ρ may have any chosen value whatever. To any value of x there corresponds a position of P, and conversely. Hence x may serve as co-ordinate of the elements of the range. If a pencil be paired with a range as above, x will equally serve for co-ordinate of the lines of the pencil; or, in the latter case, d may be taken to represent the tangent of the angle made by a varying line of the pencil with a fixed line o, called origin of angles. Any point (line) of a range (pencil) will be represented by a linear equation $ax+b=0$, the co-ordinate of the element being $-b:a$. Conversely any element is defined by such an equation. In general n elements will give rise to an equation of nth degree in x, and any such equation will represent n elements. These (points or lines) will be real or *imaginary* elements of the range or pencil according to the corresponding character of the roots of the equation. All the equations can be rendered *homogeneous* by replacing x by the ratio $x_1:x_2$ and clearing of fractions. The quantities σx_1 and σx_2, σ being any chosen finite quantity called proportionality factor, are described as *homogeneous co-ordinates* of the point (line) of the range (pencil). The position of the element depends on the ratio of the quantities, which is the same as the ratio of the x's, and the element is accordingly spoken of as the point or line (x_1, x_2). One obvious advantage of the homogeneity thus introduced lies in the artistic quality, notably the symmetry, which it lends to the analysis; for example, the equation of a point assumes the form $a_1x_1+a_2x_2=0$; in particular, the equations of the origin and P_∞ are respectively $x_1=0$ and $x_2=0$. Obvious analogous interpretations hold for the pencil. Indeed it is at once evident that the geometry of the range and that of the pencil are analytically one. The algebra remaining the same, either geometry passes over into the other on a mere exchange of notions: point (line) for line (point), pencil (range) for range (pencil).

Geometric Interpretation of Homogeneous Co-ordinates.— In case of the range assume two origins O_1 and O_2 instead of one and let them be δ apart. These divide the range into two parts, the short segment between and the long one (including P_∞) *not* between O_1 and O_2. Strictly, any point of the range other than O_1 or O_2 is between these points, for the range is a *closed* figure, but the meaning of the preceding sentence is sufficiently clear. Let it be agreed that a point in the shorter segment is on the positive side of both O's, whence, naturally, a point in the longer segment will be on the positive side of the more remote, and on the negative side of the nearer, O. Denote by x_1 and x_2 respectively the distances of any point P from O_1 and O_2. For any P, $x_1+x_2=\delta$. To any pair of x's satisfying that relation there corresponds a point, and conversely. The homogeneous co-ordinates σx_1, σx_2 of a point of a range are the distances (multiplied by any finite constant) of the point from two chosen fixed points. Analogously for the pencil, where, however, distances are replaced not by the angles but by the sines of the angles made by the variable line p with two fixed lines o_1 and o_2, and where it is understood that an angle and its vertical angle are one and the same angle.

Anharmonic Ratio.— The ruling notion in the doctrine of the range (pencil) is the *anharmonic* (double or cross) *ratio* of four elements. If x_1, x_2, x_3, x_4 be any four numbers (say any four values of a continuous variable x) the expression $(x_1-x_2 \cdot x_3-x_4)$ $(x_2-x_3 \cdot x_4-x_1)$ is called the anharmonic ratio of the four values taken in the order x_1, x_2, x_3, x_4, and is conveniently denoted by the symbol $(x_1x_2x_3x_4)$. If a one-to-one correspondence be established between the continuum of x-values and the elements of a geometric continuum, the notion of the anharmonic ratio of any four x-values may be and is associated with the corresponding four geometric elements, as the points of a range, the lines of a pencil, the planes of an axial pencil (assemblage of all planes containing a same line), and so on. The order of elements is essential. The 24 possible permutations of 4 elements yield six (in general distinct) values of their anharmonic ratio. The exchange of two alternate elements, as x_2 and x_4, inverts the ratio. Thus, if $(x_1x_2x_3x_4) = r$, then $(x_1x_4x_3x_2) = 1:r$. To exchange two consecutive elements, as x_2 and x_3, takes the complement of the ratio to 1. Thus $(x_1x_3x_2x_4) = 1-r$. The six values are r, $1:r$, $1-r$, $1:(1-r)$, $(r-1):r$, $r:(r-1)$.

Geometric Interpretation of Anharmonic Ratio in Range and Pencil.— Let x_1, x_2, x_3, x_4 be the distances of the points P_1, P_2, P_3, P_4 of a range from the origin. Then x_1-x_2, x_2-x_4, x_3-x_2, x_4-x_1 represents, in sign and magnitude the distances $P_1P_2, P_2P_4, P_3P_2, P_4P_1$. Hence $(x_1x_2x_3x_4) = (P_1P_2P_3P_4) =$ the ratio of the distance ratios $P_1P_2:P_2P_3$ and $P_1P_4:P_4P_3$. In case of a pencil, if the x's denote the tangents of the angles a_1, a_2, a_3, a_4 made by the lines p_1, p_2, p_3, p_4 with the origin, or fixed line, o, then x_1-x_2, . . . are the tangent differences tan a_1- tan a_2, . . . and $(x_1x_2x_3x_4) = (p_1p_2p_3p_4) = \{(\tan a_1 - \tan a_2)(\tan a_3 - \tan a_4)\} : \{(\tan a_2 - \tan a_3)(\tan a_4 - \tan a_1)\} = \{(\sin a_1 - a_2)(\sin a_3 - a_4)\} : \{(\sin a_2 - a_3)(\sin a_4 - a_1)\} =$ the ratio of the sine ratios $(\sin p_1p_2):(\sin p_2p_3)$ and $(\sin p_1p_4):(\sin p_4p_1)$, where p_ip_k means the angle between p_i and p_k reckoned from the former to the latter.

Special Relations of Four Elements.—These correspond to equalities among the six anharmonic ratios, and conversely. By equating r in succession to each of the other ratios, the following special values of the ratios are found: $1, -1, 0, \infty, 2, \frac{1}{2}, \omega$, and ω', the last two being the imaginary cube roots of -1. If $r=1$, the six values are $1, 1, 0, 0, \infty, \infty$; if $r=-1$, the six are $-1, -1, 2, 2, \frac{1}{2}, \frac{1}{2}$; if $r=\omega$ or ω', they are $\omega, \omega, \omega, \omega', \omega', \omega'$; finally, if $r=0$ or ∞, the six values are $0, \infty, 1, \infty, 1, 0$. The special relations accordingly fall into three cases, viz., $r=1$, $r=-1$, $r=\omega$. If $r=1$, either $x_1=x_2$ or $x_3=x_4$, i.e., two of the points (lines) coincide. Hence this case is called the *coincident* case. If $r=-1$, then, if s_1 and s_2 are the intervals into which the range (pencil) is devided by a pair of alternates, one elment of the remaining pair is in s_1 and the other is in s_2; the pair x_1, x_3 is said to be harmonically related to the pair x_2 x_4; and conversely. In particular if one of the points bisects the finite segment s_1 the alternate point bisects the other segment s_2, i.e., it is the infinite point of the range. And if one line bisects the angle s_1, the alternate line bisects the supplementary adjacent angle s_2. The case, $r=-1$, called the *harmonic* case, is of great importance, leading to the theory of involution; all point (line) pairs of a range (pencil) that are each harmonic (conjugate) to a fixed pair are said to constitute an involution of points (lines.) The case, $r=\omega$, is called *equianharmonic* (by Cremona) because the six values fall into two triplets, instead of three pairs, of equals. This case serves as a door for the entrance of imaginary elements into the geometry of the range (pencil), for obviously four *real* points (lines) cannot have an imaginary anharmonic ratio.

Conjoined Range and Pencil.— A range or any line is cut by any pencil, as in Fig. 1. If the elements be paired so that each line corresponds to the point it passes through, the range and pencil are said to be *in perspective* or to be *conjoined*. Two ranges (Fig. 2) conjoined with a same pencil are said to be in perspective; the vertex of the pencil is called the centre of perspective. Also two pencils

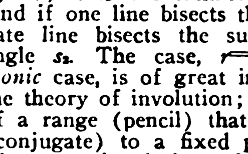

FIG. 2.

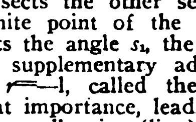

FIG. 3.

(Fig. 3) conjoined with a same range are said to be in perspective; the base of the range is named axis of perspective. If a range and a pencil are conjoined and if P_1, P_2, P_3, P_4 be any four points of the range and p_1, p_2, p_3, p_4 are the corresponding lines of the pencil, then, by definition of anharmonic ratio it may be shown that $(P_1P_2P_3P_4 = P_1P_2P_3P_4)$, a theorem which in another form was known to Pappus (about 300 A.D.). It follows that corresponding anharmonic ratios of any two perspective ranges (pencils) are equal.

If the elements of two ranges or pencils or a range and a pencil be paired in such way that corresponding anharmonic ratios are equal, the two systems are said to be *projective*. Obviously, if the anharmonic ratio of four elements of which three are known be given, the fourth element is uniquely determined. It follows that any two projective systems can be placed in perspective by a congruence transformation. To place two projective ranges P_1, P_2, P_3, P_4, ... , and P_1', P_2', P_3', P_4', ... , in perspective, it suffices to place P_1 on P_1' and to take for perspective centre the common point of the lines joining P_2 to P_2' and P_3 to P_3'. Similarly for two projective pencils.

The Anharmonic Ratio as Co-ordinate.— Let $(abcx)=r$ be the anharmonic ratio of four elements of which a, b, c are fixed and x is variable. To each value of x, i.e., to each point (line) of the range (pencil), there corresponds one value of r, and conversely. Hence the anharmonic ratio r may be taken as co-ordinate of the point (line) of a range (pencil), referred to three arbitrarily taken fixed points (lines) of it. Now, $(\infty\ 1\ 0\ x)=x$; hence, if x in case of a range denote distance from the origin, it appears that the ordinary distance-co-ordinate of a point is its anharmonic ratio referred to the infinite point, the point 1 and the origin, of the range. Similarly, if for fixed lines be taken two perpendicular lines (of which one is the ordinary origin) and the bisector of their angle, the anharmonic ratio of those lines and a (variable) fourth line is the tangent (co-ordinate) of the angle of this line and the origin. The anharmonic ratio is thus seen to be the co-ordinate par excellence of the element of any one-fold continuum.

Linear Transformation.— The importance of the anharmonic ratio in the theory of simple continua comes clearly to view in connection with the linear transformation of them. The general equation of such transformation is $x'=(ax+b):(cx+d)$. To any point (line) x corresponds one point (line) x'. Viewing the transformation as an operation on all the elements at once, we say that each element x is transformed or converted into an element x'. Obviously the range (pencil) is converted into itself as a whole, the arrangement of the elements being in general changed. It is plain, too, that the transformation can be used to pair the elements of a range (pencil) with those of a pencil (range) or to pair two ranges or two pencils. The three independent ratios of the coefficients a, b, c, d are the parameters of the transformation. Hence there are ∞^3 transformations. The successive application of any two of them is equivalent to that of a third, and so they constitute a *group* (see GROUPS, THEORY OF); and the parameters can be so determined as to convert any specified three elements into three specified elements. If x_1, x_2, x_3, x_4 be any four elements of a system (range or pencil) and if x_1', x_2', x_3', x_4' be the correspondents of the same or another system of the same or the other kind, then $(x_1x_2x_3x_4)=(x_1'x_2'x_3'x_4')$; i.e., the anharmonic ratio is an absolute invariant (see INVARIANTS) under every transformation of the group. It is this property of invariance that lends the anharmonic ratio its great importance in geometry. Because anharmonic ratios are preserved by it, the linear transformation is called projective: any two systems paired by it are projectively related. Every transformation of a system into itself leaves two elements *fixed*. These are found by writing x for x' and then solving for x. The fixed elements, variously called the *poles, foci, double* or *conjugate* elements, of the transformation, will be real and distinct, coincident or imaginary, according as the discriminant, $D\equiv(d-a)^2+4bc$, is positive, zero, or negative; and the corresponding transformations are described respectively as hyperbolic, parabolic, and elliptic,— distinctions that cannot be here further pursued. In homogeneous co-ordinates the linear transformation is defined by the pair of equations $\rho x_1'=ax_1+bx_2, \rho x_2'=cx_1+dx_2$.

Range and Pencil; Dual Elements of the Plane.— Hitherto we have been mainly concerned with the line and the point (the range and the pencil) considered in themselves. These one-dimensional spaces are now to be viewed as elements of a two fold space, the plane. In Cartesian co-ordinates the equation of the line is $Ax+By+C=0$, or $ux+vy+1=0$. The equation, which represents the line as a range of points (x, y) contains two parameters u and v, which determine the range, or line. Hence the plane is two-dimensional in ranges (lines) as well as in pencils (points). Since one and but one line is determined by any pair of values of u and v, u and v may be employed as co-ordinates of the line. We may speak of the line (u, v) as well as of the point (x, y). If u and v vary and x and y do not, the equation represents the point (x, y) as a pencil of lines (u, v). We have here simple illustrations of three important principles of modern analytical geometry. As the equation of the line contains two independent parameters, we conclude that the plane is two-dimensional in lines. The dimensionality of any space in an element is always the number of independent parameters involved in the general analytic representation of the element. This principle of "enumerating constants" to determine questions of dimensionality is one of many principles introduced into analytical geometry by Julius Plücker (1801–68). Another is that of multiple interpretation of equations. Thus we have seen that a same equation may be interpreted to represent now a point and now a line. Another great principle is that of duality or reciprocity introduced into analytical geometry by Plücker, though it was before employed in pure geometry by Poncelet (1788–1867) and his contemporary Gergonne, to the latter of whom geometric nomenclature is indebted for the world duality. Two elements e and e' of a given space are dual elements of it when its dimensionality is the same in both and when the analytic representations of e and e' are identical in form. Thus the point and the line (that is, the pencil and the range) are reciprocal elements of the plane. The analogues for space are the point and the plane, the equation $ux+vy+wz+1=0$ representing either a plane (u, v, w) as a field of points or a point (x, y, z) as a sheaf (bundle) of planes. The mentioned reciprocity of the point and the line is immediately evident in such familiar pairs of propositions as: two points (lines) determine a line (point); three points (lines) determine three lines (points). In general, to any proposition about points (lines) corresponds an immediately derivable proposition about lines (points). So arise two parallel geometries of the plane, or rather, two reciprocal aspects of one geometry. These two aspects have the same formal algorism, which is susceptible of two interpretations. Using two variables, as ξ, η, to denote either point or line, any equation $f(\xi, \eta)=0$ will represent either a curve as an assemblage or locus of points or a curve as an assemblage or envelope of lines (tangents). The degree of the equation is called the order of the locus, i.e., the number of points common to it and an arbitrary range, and it is called the class of the envelope, i.e., the number of lines common to it and an arbitrary pencil. The two curves are in general not the same. But every curve, the point and line excepted, is conceivable as both a locus and an envelope and may at once be doubly generated as such: i.e., by the figure of

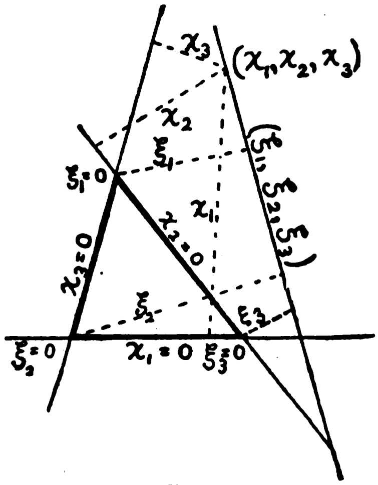

FIG. 4.

a point and a line through it so moving that the line is continuously tangent to the point's path at the point; such twofold genesis being another conception due to Plücker. Accordingly a curve has a point equation and a line (tangential) equation. For example, the ordinary point equation of the circle, centre at origin and radius r, is $x^2 + y^2 = r^2$; the line equation is $r^2(u^2 + v^2) = 1$. These are of the same degree, exemplifying the fact that every curve of second order is of second class, and conversely. In general, however, the order and the class of a curve are not equal; for example, the curve whose point equation is $x^3 + y^3 + 1 = 0$ has for line equation the sextic, $u^6 + v^6 - 2(u^3 + u^3v^3 + v^3) + 1 = 0$, and is accordingly of order 3 and class 6.

Homogeneous Point and Line Co-ordinates and their Geometric Interpretation.— By replacing x by $x_1 : x_3$, y by $x_2 : x_3$, u by $\xi_1 : \xi_3$, and v by $\xi_2 : \xi_3$, all equations of loci and envelopes may be rendered homogeneous. In particular the equation of the line (point) becomes $\xi_1x_1 + \xi_2x_2 + \xi_3x = 0$. The three ξ's (x's), or arbitrary multiples $\mu_i\xi_i$ (m_jx_j) of them on whose two independent ratios the line (point) depends, are called the *homogeneous co-ordinates of the line* (*point*). Such co-ordinates admit of various closely allied interpretations of which the simplest is that (Fig. 4), in which the x's (ξ's) are the distances of the point (line) from the sides (vertices) of an assumed fundamental triangle, or triangle of reference, signs being so determined by convention that a point within the triangle is on the positive side of the three sides and that any two of the ξ's agree or do not agree in sign according as the corresponding line does not separate or separates the corresponding vertices. Such co-ordinates are often called *triangular* or *trilinear*, plainly, they may be replaced by arbitrarily chosen multiples of them. The x's (ξ's) are, of course, not independent. If Δ denote the area of the triangle and a_1, a_2, a_3 the lengths of its sides, the distances x satisfy the identity $a_1x_1 + a_2x_2 + a_3x_3 = 2\Delta$. An analogous identity connects the ξ's. The x's and the ξ's need not be referred to the same triangle, but when they are (and that is generally the most convenient convention), the foregoing equation of the line (point) signifies also that the line and point it represents are united in position. Homogeneous co-ordinates were first employed, from mechanical motives, by Möbius in his 'Barycentrischen Calcul,' 1827, and by Plücker, from geometric motives, in his 'Analytisch-geometrischen Entwickelungen,' 1828. The artistic and economical device of denoting several co-ordinates by a single letter distinguished by subscripts was introduced by Hesse (1811–74), whose 'Analytische Geometrie des Raumes,' 1861, remains a model of elegance.

The Method of Abridged Notation, and the Conics.— This powerful method, simultaneously and independently introduced into geometry by Plücker (cf. 'Entwickelungen,' above) and by Bobillier ('Annales de Gergonne,' Vol. XVIII, 1827–28), consists primarily in denoting by a single letter the left-hand member of the equation of a curve or surface, whence the curve or surface is represented by placing the letter equal to zero. The advantages of the method, as combining ideally with the method of parameters and as greatly economizing at once both physical and intellectual energy, are obvious. For an illustration, let $P^i \equiv x_1{}^i\xi_1 + x_2{}^i\xi_2 + x_3{}^i\xi_3$ and $L^i \equiv \xi_1{}^ix_1 + \xi_2{}^ix_2 + \xi_3{}^ix_3$, then the equations $P^i = 0$, $L^i = 0$, will respectively represent a point and a line. If $P' = 0$ and $P'' = 0$ be two points, their range is represented by $P' + \lambda P'' = 0$, definite points of the range corresponding to definite values of the parameter λ; in like manner the pencil determined by two lines $L' = 0$ and $L'' = 0$ is $L' + \lambda L'' = 0$. In general the points (lines) common to any two loci (envelopes) $C' = 0$ and $C'' = 0$ are common to all the loci (envelopes) of the family $C' + \lambda C'' = 0$. If $\lambda' = (a\lambda + b) . (c\lambda + d)$, the two pencils, $L' + \lambda L'' = 0$, $L''' + \lambda' L^{iv} = 0$, are projectively related. Any pair of corresponding lines determine a point. By elimination of λ and λ', the equation of the locus, Fig. 5, of all such points is found to be $aL'L^{iv} - bL''L^{iv} - cL'L''' + dL''L''' = o$. This being of second degree in point co-ordinates, the locus is of second order, a conic containing the vertices of the given pencils. Reciprocally, the envelope, Fig. 6, $aP'P^{iv} - bP''P^{iv} - cP'P''' +$

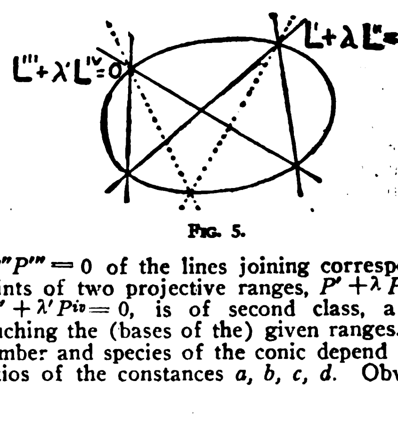

FIG. 5.

$dP''P''' = 0$ of the lines joining corresponding points of two projective ranges, $P' + \lambda P'' = 0$, $P''' + \lambda' P^{iv} = 0$, is of second class, a conic touching the (bases of the) given ranges. The number and species of the conic depend on the ratios of the constances a, b, c, d. Obviously there are ∞^3 loci of the second order (envelopes of the second class) passing through two given points (touching two given lines).

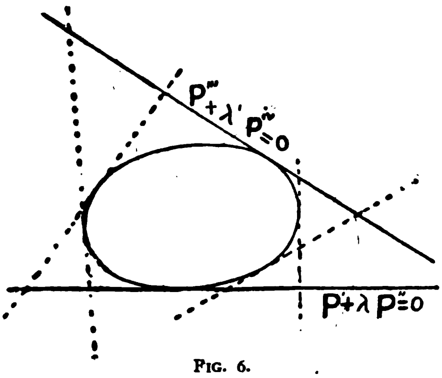

FIG. 6.

Related subjects such as the general conic, systems of conics, poles and polars, transformations, the circular points at infinity, circle and other geometries of the plane, cannot here be broached, much less the corresponding subjects in space.

Bibliography.— In addition to the works above cited, the following may be named as those which render the subject most readily accessible: Fiedler's German edition of Salmon's 'Conic Sections' and 'Geometry of Three Dimensions'; Lindemann's 'Vorlesungen über Geometrie von Clebsch' (also in French, by Benoist); Charlotte A. Scott, 'An Introductory Account of Certain Modern Ideas and Methods in Plane Analytical Geometry.'

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GEOMETRY, Non-Euclidean. A geometrical system which agrees with that of Euclid in all matters excepting those depending on the properties of parallel lines. For many centuries, in fact, until well along in the last century — the geometry handed down to us by the great Greek mathematician Euclid (q.v.) was regarded as a perfect example of all that a mathematical system should be. It was considered that the initial propositions called axioms and postulates on which Euclid grounded his system were self-evident, unassailable truths, on the validity and certainty of which the whole validity and certainty of geometry rested. Among Euclid's axioms and postulates is one to the effect that if a straight line l, meets two straight lines m and n so as to make the sum of the two interior angles on the same side of l, when taken together, less than two right angles, then m and n, if produced sufficiently far, will meet on that side on which the angles are less than two right angles. This postulate is far too intricate to be intuitively certain. Accordingly, from the very start attempts were made to replace it by simpler propositions, or to derive it from the remaining axioms and postulates of Euclid. The efforts of Proclus and of Ptolemy (q.v.) in this direction have come down to us.

This postulate of Euclid is obviously in intimate relaton to the properties of parallel lines, which are defined by Euclid as coplanar lines which do not intersect. In 1794 Ludlam pointed out that Euclid's postulate could be replaced by the postulate that two parallels to a given line cannot intersect — that is, that given a line l, and a point P, not more than one line m exists which contains P and is parallel to l. This is unjustly known as Playfair's axiom. It is not quite sufficient to secure the ordinary geometrical properties of space, for it does not guarantee that there exist any parallels whatever. If amplified to cover this contingency, it will read, «given a point P and a line l, one and only one line m can be drawn through P parallel to l.»

Before Ludlam two other modern writers had made important transformations of Euclid's postulate. Wallis (1663) stated it in the form, «To any triangle another triangle as large as you please can be drawn which is similar to the given triangle.» Saccheri (1733) put it, «There is a triangle the sum of the angles of which is two right angles.» These two forms were probably chosen by their respective discoverers in part on account of the fact that they seemed more intuitively certain than the form in Euclid. Saccheri, however, tried to demonstrate his postulate on the basis of the other axioms and postulates of Euclid by a *reductio ad absurdum*. To do this, it was necessary for him to draw the consequences of the falsity of the postulate. He considered the quadrilateral formed by a linear segment, two equal perpendiculars erected in the same direction at its extremities, and the segment connecting the free end of the perpendiculars. The angle between one of the perpendiculars and the segment connecting their free ends, in want of further information, may be considered as acute, right, or obtuse. Saccheri developed the conclusions of all these hypothesis in some detail, but believed, or said he believed, that he had found contradictions in all but the second of them.

It became obvious, however, that in some manner or other the Non-Euclidean assumptions were capable of being developed to a high degree of mathematical perfection. We find throughout the ensuing century works which claim more or less explicitly to be vindications of Euclid, but which really turn out to be Non-Euclidean geometries. Chief among these are the works of Lambert (q.v.), Schweikart, Farkas Bolyai (q.v.) and Lobachevsky (q.v.). Lobachevsky, professor of mathematics at the University of Kazan, has the credit of publishing the first book on Non-Euclidean geometry (1829–30). He developed the consequences of Saccheri's «hypothesis of the acute angle,» or as he puts it, of the axiom. «All straight lines which, in a plane, radiate from a point, can, with reference to any given straight line in the same plane, be divided in two (not empty) classes — into *cutting* and *not cutting*.» He continues, «The boundary lines of the two classes are said to be *parallel* to the given line.» He proves that if from a point P a perpendicular of length p be dropped to a line l, and a line m be drawn through P parallel to l, the angle between the perpendicular and m, or π (p), as it is called, will with a proper choice of the unit of length be $2 \tan^{-1} (e^{-p})$. The following year the young Hungarian János Bolyai (John Bolyai) (q.v.) independently published an appendix entitled, 'The Absolute Science of Space,' for a work of his father. In this a Non-Euclidean geometry is for the first time propounded without any logical misgivings. The system treated is the same as that of Lobachevsky. Bolyai demonstrates that the area of the greatest possible triangle is πk^2, where k is what is called the space-constant, and that such a triangle has all its sides parallel and all its angles zero. Among the theorems which are easily proved on the hypothesis of Bolyai and Lobachevsky are: that the sum of the angles of a triangle is less than two right angles; that parallels continually approach; that the points a given distance from a straight line and on a given side are not collinear; that the limit of a circle as the radius increases is not a straight line, but a curve; and that two perpendiculars to the same line spread apart as they recede from the line. The space of Bolyai and Lobachevsky has later come to be known as hyperbolic space. In considering the history of this period of mathematical thought, it must not be forgotten that the great Gauss interested himself in the problems of Non-Euclidean geometry, though he never published on this subject.

The next important advance in Non-Euclidean geometry was made by Riemann. In 1867, after Riemann's death, there was published an inaugural lecture which he delivered in 1854: 'On the Hypotheses which are at the Foundation of Geometry.' Here occurs for the first time the extraordinary advance that the straight line may be closed and finite; that space though unbounded may still be finite; that, for example, a finite number of our common building bricks might be written down which would be more than our universe could contain. This at once gave Saccheri's "hypothesis of obtuse angle" equal standing with his other two, giving a new genus of non-Euclidean geometry, the Riemannian.

The work of Lobachevsky, Bolyai and Riemann consisted in substituting two possible alternatives for Euclid's postulate of parallels, and of drawing the consequences from the sets of axioms made up of the remainder of Euclid's axioms and one or the other of these alternative parallel axioms. These sets of postulates have been developed and their consequences deduced in the utmost detail, and no contradictions have been found. That no contradictions have been found, however, is no guarantee that none exist. As is pointed out in the article on POSTULATES, the only way of positively proving a set of postulates consistent is the exhibition of a system which satisfies them. Since we are taking the validity of Euclidean geometry for granted, it will be enough if we give illustrations of several Non-Euclidean systems constructed out of the entities of Euclidean space.

Let us then see what concrete systems we can construct from Euclidean material that exemplify the geometrical sets of postulates embracing the two Non-Euclidean hypothesis. We shall first consider the Lobachevsky supposition on a plane. Let us take an ordinary Euclidean plane, and after the method of Cayley (q.v.) and Beltrami describe a circle on it. (Fig. 1). Let us limit our attention to those points situated on the inside of this circle, and let our lines be those linear segments bounded by the circle. It will be seen that two lines may have one of three relations: they may intersect within the circle (l and m_1), or on the circle (l and m_2), or they may fail to intersect at all in the region under consideration (l and

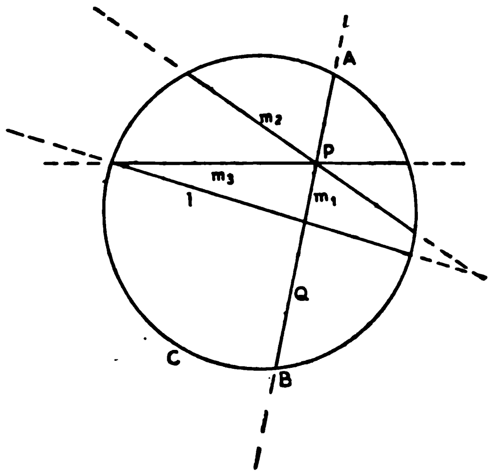

FIG. 1.

m_3). These three relations will be denominated respectively intersection, parallelism and non-intersection. It will be seen that through every point, two and only two parallels may be drawn to a given line, as is the case in a Lobachevskian geometry. If the distance between two points, P and Q be defined as

$$\frac{k}{2i} \log_e \left(\frac{\overline{AP}.\overline{BQ}}{\overline{AQ}.\overline{BP}}\right),$$

where k is an arbitrary constant, it will be found that distance defined in this manner will satisfy all those properties in Euclidean geometry that do not depend on the parallel postulate. If we call this distance $\underline{PQ}$ (to distinguish it from the Euclidean distance $\overline{PQ}$) it may be shown by the principles of projective geometry (q.v.) that $\underline{PQ}$ remains unchanged under any projective transformation which turns our defining circle into itself. We thus see that a transformation which leaves distances unchanged — that is, a *congruence-transformation* (such as an Euclidean translation or rotation) — may always be effected by a projective transformation of the defining circle or *absolute*, as it is called by Cayley, and vice versa. If we substitute a sphere for a circle, we shall get a similar representation of a three-dimensional Lobachevsky space.

The definition of angles and their measure is a somewhat more complicated matter. From every point outside a circle, as is clear, two tangents can be drawn to the circle. If we confine our attention to real, visible space, no tangents can be drawn to a circle from points on its interior. However, if instead of real space, we consider the system of number-pairs $(u+iv, w+iz)$, where $i=\sqrt{-1}$, and if we define the various geometrical entities in a manner which forms a natural extension of the corresponding definitions in real analytical geometry, we shall find that from any point on the inside of a circle two imaginary tangents may be drawn to the circle. If l and m are any two lines, then, in our plane Lobachevskian geometry, they determine at their point of intersection P two other lines, n and o, the two tangents to the absolute. Though we cannot

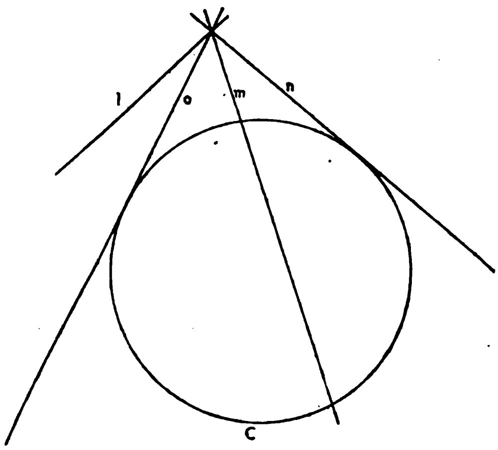

FIG. 2.

represent this by a diagram, the representation of the analogous situation, where P lies outside the absolute C, is simple enough, and is shown in Fig. 2. We shall define the angle between l and m as the appropriate value of

$$\frac{l}{2i} \log_e \left(\frac{\sin < lo. \ \sin < mn}{\sin < mo. \ \sin < ln}\right)$$

It may easily be shown that this definition will satisfy all those laws concerning angles which do not depend on the parallel postulate.

There is a mode of picturing ordinary Euclidean space which well illustrates the relation between Euclidean and Lobachevskian space. As is shown in the article on projective geometry (q.v.), we may consider that every line on a Euclidean plane possesses a point at infinity where it intersects its parallels, and that these points constitute a line with no intrinsic marks to distinguish it from any other line in

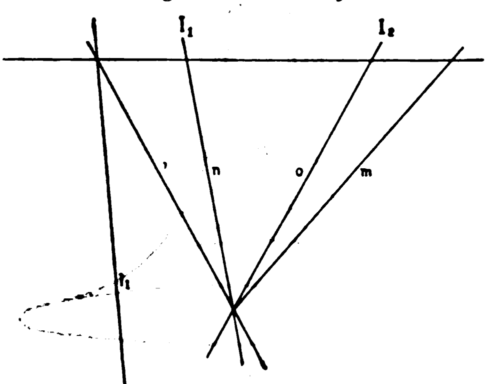

FIG. 3.

the plane. This being so, let us take a line in the finite part of our plane — the line i in Fig. 3 — and call it the line at infinity. Two lines are parallel when they meet at infinity — that is, l and l_1 are parallel when their intersection lies on i — just as in a Lobachevskian geometry two lines are parallel when they intersect on the absolute. It may furthermore be shown that the angle between the two lines l and m in this geometry is

$$\frac{l}{2i} \log_e \left(\frac{\sin < lo. \ \sin < mn}{\sin < mo. \ \sin < ln}\right)$$

when the $<$s lo, mo, mn and ln are the ordinary Euclidean angles between l and m, on the one hand, and n or o, the two lines between P, the intersection of l and m, and two fixed imaginary points on i, I_1 and I_2, on the other. In other words, the line i plays the part of the absolute as a locus of points, while the points I_1 and I_2 play the part of the absolute as an envelope, or a locus of tangent lines. Now, it is easy to see how a conic can degenerate to this condition. Consider the conic

$$\frac{x^2}{a} + \frac{y^2}{b} = 1$$

when a remains constant and b approaches 0. As a locus, it approaches $y=0$; as an envelope, the two points ($x = \pm\sqrt{a}$, $y=0$). It will be seen that Euclidean geometry, in so far as the

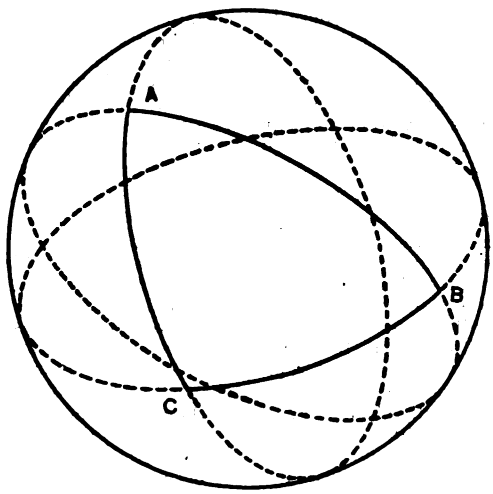

FIG. 4.

properties of parallel lines and of angles are concerned, differs from Lobachevskian geometry in that the absolute, instead of being such a typical conic as a circle, is a degenerate conic. This analogy can readily be carried to three dimensions. For a more detailed treatment of this subject and for a discussion of distances in Euclidean space see ANALYTICAL METRICS.

An analogous Cayleyan treatment of a Riemann space is possible if we make the absolute imaginary. Then it is obvious that any two real lines in the same plane will have a real intersection. This illustration, however, cannot easily be presented to the eye. An ocular illustration of a Riemann space can be made by the surface of a sphere, if we make great circles, or lines of the least spherical distance, take the place of straight lines (Fig. 4), and use the corresponding definition of angles and their measurement. This type of illustration, which was first consistently used as a method by Riemann, is historically prior to that already given. It will be observed that every two lines intersect, and that there are no parallels. All the other properties of the Riemannian plane will be found to be satisfied. However, in this type of Riemann geometry, two lines will intersect twice. By defining as our points pairs of Euclidean points diametrically opposite, we obtain another type of geometry, where two lines intersect only once. The first type is called «spherical,» the second «elliptical.» By introducing the notion of a four-dimensional space, we can regard a three-dimensional spherical space as the three-dimensional «hypersurface» of a four-dimensional hypersphere. This is merely illustration of a Riemannian space, however, and not the logical foundation for the theory of such spaces.

Among the axioms of geometry which do not depend on the parallel postulate there are those which secure the free mobility of any figure in space. This means that space is the same in nature throughout and that any figure can be carried along it without stretching or tearing or crumpling. This is obviously true of the plane and the surface of the sphere, it is also true, however, of certain other surfaces, at least if the dimensions of the figure are sufficiently small. There is a certain expression involving the equation of the surface and the coordinate of a point, called the *Gauss curvature* (see SURFACES, THEORY OF) which will be constant on all such surfaces, and only on such surfaces. Among the surfaces of constant Gauss curvature is that which is formed by revolving the tractrix

$$x = a\ sech^{-1}\ (y/a) - \sqrt{a^2-y^2}$$

about the x-axis. (Fig. 5). It will be seen that this surface is everywhere saddle-shaped. Consequently no portion of it can be transferred by mere bending, without tearing or crumpling to a plane or a sphere, as it will always be too «full» about the edges. The geometry of this surface, then, though Non-Euclidean, must belong to a different type than that of the sphere, and as we should expect, turns out to be essentially Lobachevskian. The analogues of straight lines are naturally those curves which, if we take sufficiently small parts of them, represent the shortest distance between the points they join — that is, the geodesics. Angles retain their usual definition.

The tractrix space, however, is not a complete Lobachevskian plane, but a portion thereof with its edges joined to themselves by the same process by which a cylinder can be formed from a strip of Euclidean plane. Now, while a small piece of cylindrical surface can be moved on the cylinder without stretching, tearing, or crumbling, a portion reaching entirely around the cylinder cannot be rotated freely. In the tractrix surface of revolution, free mobility is likewise confined to regions that are sufficiently small. We thus see that besides the four canonical types of space in which alone, as was shown by Lie, free mobility is always possible — the Euclidean, Lobachevskian, elliptic and spherical spaces — other types can be formed which agree with one or the other of these spaces in regions less than a certain size, in which the free mobility of figures is also confined to figures of less than a certain size. Spaces of this sort may be of two or three or even more dimensions, and are characterized by multiple connectedness — that is, it is possible to draw two closed curves in one of these spaces which cannot be transformed into one another by a continuous series of distortions. The theory of multiple connected spaces was developed by Clifford (q.v.).

As would be expected from the fact that we have given the geometry of the surface of the sphere as an example of a Riemannian geometry, the formulæ of spherical trigonometry will carry over into Riemannian space. Thus we have $\sin \frac{a}{k} : \sin \frac{b}{k} : \sin \frac{c}{k} = \sin A : \sin B : \sin C$, *where a, b, and c are the sides of a triangle; A, B and C the angles opposite them; and k the constant which appears in the distance-expression of the space in question. (As will be remembered the distance between P and Q was equated to $\frac{k}{2i}$ times the natural logarithm of the cross-ratio between P and Q, on the one hand, and the points where PQ cuts the absolute, on the other). This sine-law is precisely the formula which holds on a sphere of radius k. If k is a pure imaginary, this formula becomes the law of sines for a Lobachevskian space. Again, in a spherical triangle, the area is proportional to the difference between the sum of the angles and 180 degrees. This is true in both Lobachevskian and Riemannian space, where the area is in fact k^2 times this difference. In a spherical or Riemannian triangle, as can be seen from Fig. 5, this difference is an excess of the sum of the angles over 180 degrees, while in the Lobachevskian triangle, as in the case of Fig. 5, it is of the nature of a defect. Because k^2 is positive in the first case and negative in the second the area is always positive.

The reciprocal of this quantity $\frac{1}{k^2}$ is called the *curvature* of the space. It may be shown that it is identical with the Gauss curvature on a surface of constant curvature, if the geodesics of the latter be interpreted as straight lines and the angles receive their Euclidean measure. It will be noticed that it is definable entirely in

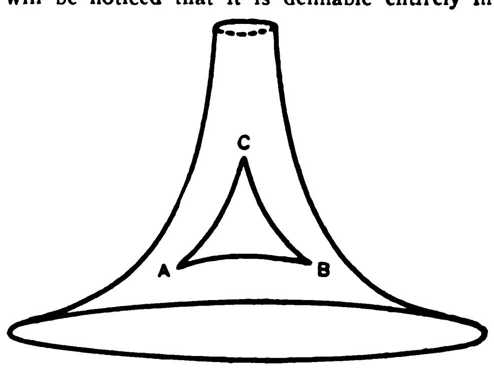

FIG. 5.

terms of the Non-Euclidean space to which it pertains, as is shown by the trigonometric formulæ given above, and involves no tacit reference to a Euclidean hyperspace. It is

*The definition of sin is purely analytical, not geometrical.

positive in a Riemannian space, zero in a Euclidean space, and negative in a Lobachevskian space.

All three types of space can be exemplified by the selection of entities from Euclidean space, as we have seen, and the three therefore have an equal mathematical right to exist. None of them is in any sense imaginary or hypothetical. As to the particular space of up and down, right and left, back and front in which we live, the usual assumption made is that it is Euclidean. It is certain that if it is Non-Euclidean, its curvature must be very small in comparison with those curvatures which we are accustomed to measure, if our ordinary criteria of distance hold good, for we find that in the course of our surveying or even of our astronomical observations of parallax no error has been found which depends on supposing our geometry to be Euclidean. It is quite possible, however, that our space is Non-Euclidean, as a very small value of the curvature could not be distinguished from 0 by any measurement within our power. The fact that Riemannian space is finite, and that Riemannian lines are closed, does not exclude our world from being Riemannian, for we have no way of knowing that these suppositions are not so. The closedness of the Riemannian line might seem to make it probable that in such a space we could see the same stars by looking in either direction, so that the heavens would appear symmetrical with regard to the centre of the earth. By supposing a small space-curvature and an absorption of light in space, this difficulty may be overcome. If the world is Non-Euclidean, this fact could theoretically be demonstrated by sufficiently precise measurements. It must be remembered, however, that our physical definition of distance is not altogether determinate, but as Henri Poincaré has shown involves a large number of imperfectly analyzed factors, and that one of the unconscious motives which have led it to assume its present form is probably the superior simplicity of Euclidean space. See ANALYTICAL METRICS; GEOMETRY, ELEMENTARY; GEOMETRY, PURE PROJECTIVE; SPACE, etc.

Bibliography.— For the early sources on the subject, in so far as they are available in English, consult Lobachevsky, 'Theory of Parallel Lines' (Berlin 1840; trans. by Halsted, Austin, Texas, 1891); Bolyai, János, 'The Science Absolute of Space' (1831; trans by Halsted, Austin, Texas, 4th ed., 1896). For the subject itself, consult Barbarin, P., 'La geometrie non-Euclidienne' (Paris 1902); Bonola, R., 'La geometria non-Euclidea' (Bologna 1906); Burnside, W., 'On the Kinematics of non-Euclidean Space' (*Proc. Lond. Math. Soc.;* v. XXVI, 1894); Coolidge, J. L., 'The Elements of Non-Euclidean Geometry' (Oxford 1909); Fontene, J. L., 'Hyperspace à (n—1) dimensions' (Paris 1892); Halsted, J. B., 'Rational Geometry' (New York 1904); Killing, W., 'Die nicht-Euklidischen Raumformen in analytischer Behandlung'; Klein, F., 'Zur nicht-Euklidischen Geometrie' (*Math. Annal,* v. XXXVII); Study, E., 'Uber nicht-Euklidsche und Liniengeometrie' (*Jahr. d. Deutsch Math. Ver.,* v. XV, 1906); Veronese, G., 'Fondamenti di geometria' (Padua 1891); Whitehead, A. N., 'Universal Algebra' (Cambridge 1898); 'The Geodetic Geometry of Surfaces in Non-Euclidean Space' (*Proc. Lond. Math. Soc.,* v. XXIX).

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GEOMETRY, Pure Projective. Introductory.— Projective geometry, as the name indicates, has to do with the theory of projection. Pure projective geometry is that which is conducted by means purely geometric, without initial recourse to algebraic methods (see GEOMETRY, MODERN ANALYTICAL), and which makes only subordinate mention of properties other than projective. The adjective synthetic is frequently used as practically a synonym for pure.

The process of projection is of constant occurrence — e.g., in photographing (the lens must be strictly rectilinear), in preparing a lantern-slide from the photographic plate and in throwing the image upon a screen. Thus in passing from an object to its representation upon the screen there are three successive projections — a fourth enters with the visual image formed upon the retina when the screen is viewed. Fig. 1 serves to illustrate the process of projecting a line $ABCD$ into another $A''B''C''D''$.

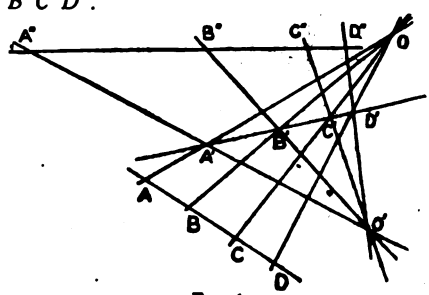

FIG. 1.

Reference to the figure will show that the length of a line is changed by projection. AB is not equal to $A''B''$. Moreover, even the ratio of two lengths is changed. $AB \div BC$ is not equal to $A''B'' \div B''C''$. The study of projective geometry is the study of such properties of figures as are unaltered by successive projections. Lengths and ratios of lengths are not such properties and by right enter only subordinately into pure projective geometry.

Historically considered, projective geometry arose by considering changes in lengths and was thus far from pure. A theorem attributed to Pappus (q.v.) states that the double ratio of the lengths is unchanged by projection — thus,

$$\frac{AB}{BC} \div \frac{AD}{DC} = \frac{A'B'}{B'C'} \div \frac{A'D'}{D'C'} = \frac{A''B''}{B''C''} \div \frac{A''D''}{D''C''}.$$

It was upon such basis as this that the subject developed until von Staudt (q.v.) in his famous 'Geometrie der Lage,' published in 1847, showed how the development might proceed in a manner more truly in the spirit of pure projective geometry. From the publication of this book dates the modern point of view in treating projective geometry as a pure self-sustaining branch of mathematics. It is this point of view that is here adopted.

Fundamental Notions.— Properly to appreciate pure projective geometry it is necessary definitely to take a point of view radically distinct from that taken in ordinary elementary geometry. This may perhaps be done best by making a first appeal, as von Staudt did, to the physical sensation of sight. What characterizes ordinary geometry (which is usually called metrical, as opposed to projective geometry) is its close relation to the conceptions of rigid motion, of distance and of measurement — in short, to things connected with the sensation of touch. Whereas projective geometry is intimately concerned with the look (Schein) or projection of objects and not with their actual dimensions. Thus in the figure the set of points A, B, C, D would have the same 'look' to an observer at O as would A', B', C', D'; and these in turn would appear the same from the point O' as would A'', B'', C'', D''. There is, however, one respect in which the idea of 'looking' must be generalized. If the view-point is situated, between the points A', B', C' and A'', B'', C'', as in Fig. 2,

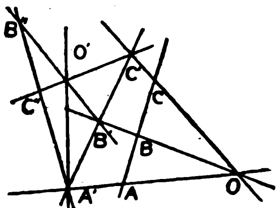

Fig. 2.

the sets of points are still said to "look" the same, or to be projections of one another with respect to the point O'. Precisely herein lies the distinction between projective geometry and what has been called descriptive geometry. (B. Russell, 'Principles of Mathematics,' p. 393). Namely, the former considers the line of vision or projection to be the whole line through the point of observation, whereas the latter takes it as merely a half-line and thus corresponds somewhat more closely to the real visual space.

The point, the straight line and the plane are assumed as the fundamental geometric elements. They are denoted respectively by italic capitals A, B, C, . . . ; by lower case italics, a, b, c, . . . ; and by Greek letters, α, β, γ, . . . It may be noted that these elements are themselves projective, that is, appear respectively as points, line and plane from any view-point not situated upon them. A circle has not this property: for when viewed from any point, not upon the line through its center and perpendicular to its plane, it appears non-circular. Hence the circle could not serve as a fundamental locus in pure projective geometry.

Fundamental Propositions. Parallelism. — There are a considerable number of immediately obvious relations connecting the fundamental elements, points, lines, planes. From among these it is necessary to select a certain number to serve as fundamental propositions or premises for future deductions. (Note. The propositions so selected may be called axioms or postulates. This, however, is not the place to discuss such matters, which belong to the foundations of mathematics. See Logic, Symbolic and Postulates.)

F. P. 1. Two points determine a line — the line joining them and upon which they lie.

F. P. 2. Two planes determine a line — their line of intersection and through which they pass.

F. P. 3. Three points not in the same line determine a plane — the plane passed through them and in which they lie.

F. P. 4. Three planes not passing through the same line determine a point — their point of intersection.

F. P. 5. A point and a line not passing through the point determine a plane.

F. P. 6. A plane and a line not lying in the plane determine a point — their point of intersection.

From these propositions follow a number of theorems:

Th. 1. If two points lie in a plane, the line joining them lies wholly in the plane. Proved from F. P. 3 and F. P. 5.

Th. 2. If two planes pass through a point, their line of intersection passes through the point. Proved from F. P. 4 and F. P. 6.

Th. 3. If two lines have a point in common, they determine a plane. Proved by F. P. 3 and Th. 1.

Th. 4. If two lines lie in the same plane, they intersect in a point. Proved by F. P. 4 and Th. 2.

Th. 5. If two triangles are so situated that the lines joining corresponding vertices meet in a point, the points of intersection of corresponding sides lie on a line.

The proof in case the triangles do not lie in the same plane is as follows: Let ABC and $A'B'C'$ be the triangles. As AA' and BB' meet in a point, the lines AB and $A'B'$ determine a plane (Th. 3, Th. 1) in which they intersect (Th. 4). But as AB lies in the plane ABC, and $A'B'$ in the plane $A'B'C'$, they can only intesect on the line common to these two planes. Hence the intersection of AB and $A'B'$ is on this line. Similarly BC and $B'C'$, and CA and $C'A'$, intersect on this line. The proof in case the triangles lie in the same plane is obtained by comparing each of them with a triangle out of their plane.

Th. 6. Converse of Th. 5. Proof similar.

Th. 7. If two triedral angles are so situated that the lines of intersection of corresponding faces lie in a plane, the planes determined by corresponding edges pass through a line. The proof follows that of Th. 5.

Th. 8. Converse of Th. 7. Proof similar.

From the point of view of elementary geometry theorem 4 is incorrect and should read 'if two lines lie in the same plane they either intersect or are parallel.' What has become of parallelism? Reflection will disclose that for projective geometry there is no such thing as parallelism. For, consider two parallel lines upon a horizontal plane and project them upon a vertical plane (as is done in photographing a straight, flat railroad track). In the projection the lines meet upon the horizon (Fig. 3). Thus the property known as parallelism in elementary geometry is not unchanged by projection and cannot enter into projective geometry. From the visual point of view all lines seem to intersect. F.P.2, F.P.4 and F.P.6 are subject to the same comment. From this it will be seen that the statements for projective geometry are much simpler than those for elementary geometry, inasmuch as no special cases or exceptions need be introduced to cover the possibility of parallelism. At first this might seem unnatural or even wrong, but it is in the true spirit of the subject and after a little usage appears as one

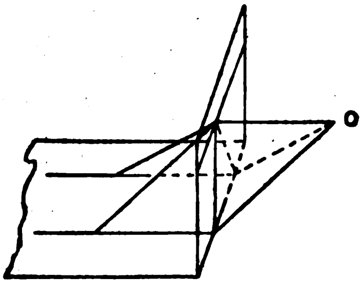

FIG. 3.

of the principal beauties. The points which must be assigned to ordinary space to make parallels meet are called the points at infinity and in a projective n-space constitute an $n-1$-space — the $n-1$-space at infinity. This is projectively indistinguishable from any other $n-1$-space. The term «at infinity» is convenient in expressing the relations of projective to elementary geometry (§ 7), but it must not be allowed to introduce confusion. There is no such thing as distance, much less infinite distance or infinity, in pure projective geometry. (See, however, § 8).

4. Harmonic Elements. Duality.— A set of points situated upon a line is called a *range*. A set of planes passing through a line is called a *pencil* of planes. A set of lines lying in a plane and passing through a point is called a *pencil* of lines.

It may be said that the fundamental construction of projective geometry is the construction of a harmonic range. Given a pair of points A, B on a line (Fig. 4) and a third point C. To find the fourth harmonic point D draw through C any line. In the same plane draw AE and BE cutting the line through C in F and G. Join F to B and G to A by lines interesecting in H. Draw the line connecting E and H and let it cut the line AB in D. Then D is said to be the fourth harmonic point in the range $AB \cdot C$. It may be proved by the theorems given above that: 1° no matter how the construction be carried

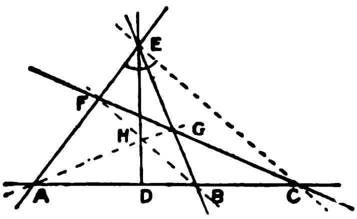

FIG. 4.

out, it always leads to the same point D; 2° if the three given points be $AB \cdot D$, the fourth harmonic is C and hence the pair of points C, D may be said to divide the pair A, B harmonically; 3° the pair A, B also divide C, D harmonically and hence the pairs $AB \cdot CD$ may simply be called harmonic pairs or a harmonic range.

A pencil of lines such as $E\text{-}AB \cdot CD$ which cuts a line in a harmonic range is by definition a harmonic pencil. It may be shown that if any line cuts a harmonic pencil, the range of points is harmonic. Similarly if a pencil of planes cuts one line in a harmonic range, it cuts every line in a harmonic range and is said to be a harmonic pencil. The harmonic property is thus evidently a true projective property, being unchanged by projection.

A characteristic of higher geometry is the frequent use of correspondences — that is, of methods for obtaining from a given group of theorems another group merely by substituting different words in the statement of the given theorem. The simplest of these correspondences is duality. There are several dualities established in projective geometry. Of these the most important are duality in space and duality in the plane.

Spatial duality is obtained by substituting respectively for «point,» «line,» «plane,» the words «plane,» «line,» «point,» and making such corresponding changes from «pass through» to «lie on» as may be necessary. In the fundamental propositions the duality appears. Thus F. P. 1 and F. P. 2 are dual statements. The same is true of F. P. 3 and F. P. 4 and of F. P. 5 and F. P. 6. As this dual relation extends through all the fundamental propositions, it must extend through all propositions immediately derived from them. For, the proof of a dual proposition may be given by merely making in the proof of the given proposition the same changes as in its statement. As this may be done at every step, the two sets of propositions may be developed side by side, and the duality can never break down until the introduction of some additional definition or fundamental proposition which is not accompanied by its dual. Thus Th. 1 and Th. 2 are dual, and the proof of Th. 2 is the exact dual counterpart of the proof of Th. 1.

The duality in the plane may be obtained by substituting for «point» and «line» the words «line» and «point.» A «range of points» becomes a «pencil of lines» and vice versa. Thus Th. 1 and Th. 4, and in case the construction be confined to a plane Th. 5 and Th. 6, are duals. According to the definitions above given it did not appear that the harmonic pencil was the dual of the harmonic range. It is, however, possible to give for a harmonic pencil a construction which is the dual of that given for the range, and it may be proved that this construction is equivalent to the earlier definition. Therefore all theorems concerning harmonic properties have dual counterparts.

If four lines no three of which pass through the same point be drawn in the plane, they will intersect in six points. This figure is called the *complete quadrilateral* (the heavy lines of Fig. 4, except ED. The three dotted lines are the three diagonals). In a dual manner the six lines which may be drawn through four points (no three of which lie on a line) in the plane constitute the *complete quadrangle*. The properties of these two figures are much studied in plane projective geometry.

5. Order, Continuity, Projectivity, Correlation.— If three lines a, b, c, lying in a plane, pass through a point, they determine a certain *order* in which the pencil may be conceived as described by a movable line — the order abc

to which *cba* is opposed. Two lines alone cannot determine the order of description: for it is possible to pass from one to the other in either of two ways. Similarly three points upon a line determine an order upon the line, and three planes through a line fix an order about that line; but two cannot. (See § 7). Thus a new element, *order,* is added to the fundamental elements, point, line, plane. It is intuitively obvious that:

F. P. 7. Order is unchanged by projection. Thus if a point describe a range in the order *ABC*, its projection will describe the projected range $A'B'C'$ in the same order. (See Figs. 1 and 2).

One more fundamental proposition, the so-called postulate of continuity, the importance of which is quite overlooked in all but the best and most recent works, may be stated as follows:

F. P. 8. If a line be ordered and if Y follow X in that order; if, moreover, the points of the segment XY be divided into two classes so that 1° every point of the segments belongs in one of the classes and 2° every point of one class precedes all points of the other class, then there must be a point Z in the XY such that every point which precedes Z lies in the first class and every point which follows Z lies in the second.

If one range may be obtained from another by successive projection, the two ranges are said to be projective. The relation between the ranges is called a *projectivity.* (Similar definitions cover the relations between ranges and pencils or between two pencils. For simplicity the treatment will be confined to ranges).

Fundamental Theorem.— Three corresponding points A, B, C and A', B', C' determine uniquely the projectivity between two ranges. That three elements of one range may be projected into any three elements of another range may be seen from Fig. 2. That the projective relation is thereby uniquely determined follows from F. P. 8. In like manner the correspondence of four points, no three of which lie on a line, determines the projectivity between two planes (which may coincide); and five points determine the projectivity between two three-spaces (these must coincide) in a three-dimensional projective geometry.

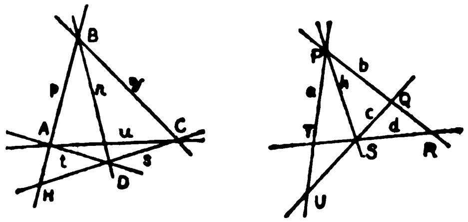

Plate 1. Plate 2.

FIG. 5.

If the points of the plane are placed in correspondence with the lines of a second plane (which may be coincident with the first) in such a manner that to each point corresponds one line and conversely, and to the intersection of two lines corresponds the line joining their corresponding points, the relation is called a *correlation.* A correlation is completely determined by the correspondence of four given elements. (In the figure corresponding elements have the same letters).

6. Conics.— If in one and the same plane a correlation be so established that when the point P corresponds to the line p, then conversely the line p corresponds to the point P, the correlation is called a *polarity.* Corresponding points and lines are *poles* and *polars* in the polarity. In general the poles do not lie on the polars: But certain of the poles do usually lie on their polars. The locus of the poles which lie on their polars is a curve to which the polars themselves are tangent and is called a *conic.* This definition is self-dual. A large number of theorems and their duals follow from the definition. For example, with their duals:

1. Pole, polar and conic cut out a harmonic range on any line through the pole.
2. The locus of the intersections of corresponding lines of two projective pencils is a conic.
3. If a hexagon be inscribed in a conic, the points in which the three pairs of opposite sides intersect lie on a line.

This last is the famous Pascal's theorem, which with its dual, Brianchon's theorem, is very useful in the theory of conics. The second theorem is taken to define conic sections by many less modern writers. It is a very convenient graphical method. From it the various other properties may be deduced, though with much less directness and power than in the way here sketched. The first theorem is taken to define pole and polar by most of the writers who base conic sections on the second theorem. Another method of treating poles and polars is to consider projectivities not merely on a line but on a conic. The points of a conic are associated so that to each point $A, B, C, \ldots$, corresponds a point $A', B', C', \ldots$ Three pairs of corresponding points determine the projectivity. If it so happens that $A', B', C', \ldots$, correspond conversely to A, B, C, the projectivity is called *involutory* (just as the polarity was the involutory correlation, § 4) or merely an *involution.* The study of involutions on a conic leads to an elegant theory of poles and polars.

Quadric surfaces may be defined analogously to conic sections. The treatment of cubic curves on such surfaces has been considerably developed. The treatment of plane curves of order and class higher than conics may be developed to some extent synthetically, but is generally carried on analytically. (See CURVES, HIGHER PLANE). The linear and tetrahedral line complexes and certain line congruences have received synthetic treatment. The analytical discussions are, however, better known. See GEOMETRY, LINE-.

7. Relations to Metrical Geometry.— If the word meet be changed to meet or are parallel, every theorem of projective geometry becomes a theorem of metrical geometry. But in order conversely to interpret a metrical theorem as a theorem of projective geometry, it is first necessary to state the theorem in terms unchanged by projection — that is, in terms of double ratios (§ 1). This is usually done in one of two ways.

First, if the point D retreats indefinitely,

AD/DC approaches -1 and the double ratio

$$\frac{AB}{BC} \div \frac{AD}{DC}$$

approaches the simple ratio AB/CB. Thus any ratio in metric geometry may be turned into a double ratio and rendered projective by adding the point at infinity upon the line to the three finite points A, B, C. In the particular case of a harmonic range (§ 4) $AB.CD$ if D be at infinity, C bisects AB. This introduction of a point at infinity also accounts for the fact that a pair of points AB suffice in metric geometry to determine an order on the line (§ 5). The order is that of $AB\infty$.

The relation between metric and projective geometry may be used to obtain metrical theorems from projective theorems by specialization of the figure, or to obtain projective theorems from metrical by generalizing the figure by projection. Thus the theorems "the diagonals of a parallelogram bisect each other" and "a diagonal of a complete quadrangle is divided harmonically by the other two diagonals" may be obtained one from another. (See. Fig. 4).

Second, the double ratio of four lines a, b, c, d may be written as

$$\lambda = \frac{\sin \measuredangle ab}{\sin \measuredangle bc} \div \frac{\sin \measuredangle ad}{\sin \measuredangle dc}.$$

If only a simple angle such as $\measuredangle bd$ is given, the two other lines of the pencil may be assumed to be the "minimal lines" or "lines to the two circular points" of the plane of the first two lines determined by

$$x \pm \sqrt{-1}\ \ y = 0.$$

These circular points are the intersections of these lines with the line at infinity. The double ratio λ becomes

$$\lambda = e^{2\phi i} = \cos 2\phi + i \sin 2\phi,$$

$$\phi = \frac{1}{2i} \log \lambda.$$

Thus an angle ϕ has been expressed in terms of a double ratio λ by the introduction of the two circular points. If, in particular, ϕ is a right angle, $\lambda = -1$, and the pencil is harmonic.

The properties of circular points most necessary to establish the relation of metrical to projective geometry are: They lie on the line at infinity. All circles pass through them. the lines (imaginary) joining the centre of a circle to the circular points are tangent to the circle. Thus the theorem "the locus of the vertex of a right angle (or any angle) whose sides pass through two fixed points is a circle through the fixed points" becomes "the locus of the vertex of a harmonic pencil (or any pencil of constant double ratio) whose sides pass through four fixed points (two of these correspond to the circular points) is a conic section passing through the four fixed points."

8. Relations to Analytic and Non-Euclidean Geometry.— The fact that in metrical geometry the point 1 upon a line is halfway between the points 0 and 2 furnishes a clue for constructing a projective scale purely by harmonic constructions. Let three points A, B, C be arbitrarily assigned the numbers 0, 1, ∞. By finding the fourth harmonic to 0 with respect to 1 and ∞, a point is constructed to which the number 2 is assigned. In like manner all the positive integers may be located. The negative integer $-N$ is assigned to the point harmonically situated with respect to $+N$ and the pair, 0, ∞. By projecting 0, N, ∞ into 0, 1, ∞ the points $1/N$, $2/N$..... can be located. Thus all the rational numbers are assigned to points on a line. By use of F.P P. 8 it may be shown that to each point of the line corresponds a number rational or irrational or ∞, and to each number corresponds just one point.

To obtain a system of co-ordinates for the plane, assume two lines in the plane. Mark their intersection as 0 and upon each of them mark arbitrarily the points 1, ∞. Then to

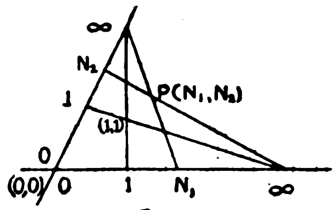

FIG. 6.

each point of each line corresponds one number. To find the co-ordinates of any point P of the plane draw lines connecting P to the two infinite points. The points in which these intersect the given two lines furnish the co-ordinates of P. A more convenient system may be obtained by rendering the co-ordinates homogeneous. (See GEOMETRY, MODERN ANALYTICAL). Upon this purely projective basis all analytical geometry may be built up. The system is evidently that which is obtained by projecting the ordinary Cartesian system of co-ordinate axes into the system here assumed. In practically all treatises upon analytical geometry the co-ordinates are introduced as metrical quantities and are only later proved to be truly projective. Analytical projective geometry is closely related to Invariants and Covariants (q.v.), Geometry of Hyperspaces (q.v.), Modern Analytical Geometry (q.v.), Higher Plane Curves (q.v.) and Determinants (q.v.).

Projective geometry includes in itself not only metrical geometry, but the ordinary non-Euclidean geometries as well. This is seen from examining the fundamental propositions upon which those geometries are based, or, better, by following the analytical method of A. Cayley (q.v.), and defining distance in the various geometries as the logarithm of a double ratio. See GEOMETRY, NON-EUCLIDEAN.

9. New Problems and Bibliography.— It may well be said that pure projective geometry, which rose with von Staudt in 1847 and was carried on by numerous investigators during the next 50 years, has now reached a stage that is near finality, and that new problems are likely to be on neighboring fields. Thus at present there is a great deal of work on the foundations of mathematics. For pure projective geometry this means the determination of one or more sets of postulates and fundamental concepts which shall be 1° projective, 2° complete, 3° compatible, 4° independent and irreducible, and 5° as nearly self-dual as possible. This problem has been settled in a wholly satisfactory manner by the researches of Pieri, Schur, Moore, and especially Young and Veblen. The fundamental propositions assumed in earlier sections are far from satisfying rigorously all these conditions. They are, however, sufficiently good for most purposes.

The theory of involutory projectivities has been satisfactorily developed as far as its application to transformations which leave a quadratic form fixed is concerned, but for the general case there remains much to be done. And so with many other special problems which might be enumerated.

Of late Wilczynski has been developing a projective theory of curves and surfaces which, though not wholly in touch with pure projective geometry, promises valuable additions to the subject.

A bibliography of memoirs and books may be found in the historical account of the subject by Ernst Kötter, 'Die Entwickelung der synthetischen Geometrie'; consult also 'Encyclopedie der mathematischen Wissenschaften' (Vol. III, Pt. 1), and the improved French edition, 'Encyclopédie des Sciences Mathématiques' (Tome III, Vol. II, 1-143). The following textbooks may be cited: 'Beiträge zur Geometrie der Lage' (1856-60); Böger, 'Geometrie der Lage' (1900); Cremona, 'Projective Geometry' (1893; trans. by Leudersdorf); Duporcq, 'Premiers principes de géometrie moderne' (1899); Enriques, 'Lezioni di geometria projettiva' (1898; trans. into German as 'Vorlesungen über projektive Geometrie,' (1903); Poncelet, 'Traité des Projections' (1866); Reye, 'Geometrie der Lage' (1892-99; partly trans. as 'Geometry of Position' by Holgate in 1898); Sannia, 'Geometria Projettiva' (1895); Steiner, 'Vorlesungen über synthetische Geometrie' (1898); Veblen, O., and Young, J. W., 'Projective Geometry' (2 vols., 1910-17).

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GEOMORPHOLOGY (Greek *gē*, earth, *morphē*, form, and *logos*, speech). The science of the development of the configuration of the surface of the earth, i.e., the sculpturing of mountains, hills, valleys and shores, the accumulation of wind blown sand, lavas and other detrital materials, the development of plains, terraces, deltas, talus and spring deposits, coral reefs and fault scarps, the relations between land forms and rock structure and the history of uplift and degradation and the topographic features which result. Geomorphology is largely a branch of geology (q.v.) because the processes are all geologic but the results are geographic and especially physiographic, therefore geomorphology is by many regarded as a branch of physiography (q.v.). The word geomorphogeny is used as an equivalent by some writers. Most treatises of geology and physiography devote a large portion of their contents to a discussion of the origin and development of earth forms. J. W. Powell, G. K. Gilbert, W. M. Davis and Geikie have given great impetus to the study of geomorphology. (See GEOLOGY; PHYSIOGRAPHY). Consult Powell, J. W., 'Explorations of the Colorado River of the West'; Gilbert, G. K., 'Geology of Henry Mountain'; Powell, J. W., and others, 'Physiography of the United States'; Davis, W. M., 'Physical Geography'; Geikie, J., 'Earth Sculpture'; Davis, W. M., 'Erklärende der Landformen'; de la Noë, G., and de Margerie, Emm., 'Les form du Terrain'; Penck, 'Morphologie der Erdoberfläche'; de Martonne, E., 'Traité de géographie physique'; Lapparent, A., 'Leçons de géographie physique'; Salisbury, R. D., 'Physiography'; Tarr, R. S., and Martin, L., 'College Physiography'; Salisbury, R. D., and Atwood, W. W., 'Interpretation of Topographic Map' (U. S. Geol. Survey, Prof. Paper 60); Suess, E., 'Das Antlitz der Erde'; Fraas, E., 'Scenerie der Alpen.'

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GEOPHAGY, jē-ŏf'a-jĭ, **GEOPHAGISM** or **DIRT-EATING**, the practice of eating some kind of earthy matter, as clay or chalk, common among uncivilized peoples, such as the South American Ottamacs, the Indians of the Hudson Bay country, the West Indian blacks, the negroes in some of the United States, and among the less civilized whites in the mountain districts of Tennessee and Kentucky. In some cases it is probably used to allay hunger, but it is also practised where the supply of food is sufficient. Among chlorotic young women a similarly depraved appetite is not uncommon. It is likely to terminate fatally in dropsy or dysentery. See HOOKWORM DISEASE.

GEOPHILOUS PLANT. See GEOPHYTE.

GEOPHYTE, a perennial plant of which the principal organs lie under the ground. For them winter is a rest period but in summer they put forth aerial organs. Bulbous plants such as onions and lilies are of this class. In some species the entire plant is hidden during the period of rest, in others some organs are visible. Of the latter lawn grasses and clovers offer good examples.

GEOPONICI, Greek term used to designate both Roman and Greek writers on agriculture and kindred topics. The chief names in this field are: of the Greeks, Democritus, Aristotle, Theophrastus and Xenophon; of the Romans, Cicero, Horace, Cato the Censor, Varro Columella and Palladius. Consult Schneider, J. J., 'Scriptores Rei Rusticæ' (4 vols., Leipzig 1797; 3d ed., 1821) and Megerstedt, 'Bilder aus der römischen Landwirtschaft' (5 vols., Sonderhausen 1862).

GEOPONIKA, a Greek work on agriculture, which reached its present form about the 10th century. It was compiled from an earlier work of the 6th century and by some is supposed to be based on the Latin translation of a work of Mazo the Carthaginian by order of the Roman Senate. In it are cited most of the authorities of the ancients. There are extant translations in Arabic, Syrian and Armenian. For a good edition consult that by Beckh (Leipzig 1895). Consult also Krumbacher, 'Byzantinische Litteraturgeschichte' (Munich 1897).

GEORGE, Saint, the especial patron of chivalry and tutelary saint of England: d. Nicomedia, 23 April 303. Though venerated both in the Eastern and Western Churches, his history is extremely obscure, the extant accounts containing very much less history than legend. The story in the 'Acta Sanctorum' ('Deeds of the Saints') is that he was born of noble Christian parents in Cappadocia, became a distinguished soldier, and after testifying to his faith before Diocletian, was tortured and put to death. He was adopted by the Genoese as their patron saint, and in 1222 the Council of Oxford ordered that his day (the 23d of April) should be observed as a national holiday in England. In 1344 an order was instituted in his honor by Edward III, and in 1350 this was made the Order of the Garter, of which accordingly Saint George is the patron.

GEORGE, Duke of Clarence and brother of Edward IV, king of England; b. 1449; d. 1478. He espoused the cause of Henry VI and his queen, Margaret of Anjou, against his brother and sovereign. He married in 1469 Isabella, daughter of the Earl of Warwick, and joined him in his rebellion, took the king prisoner, but was forced to release him. He afterward deserted to Edward and fought on his side. Some years afterward he sought the hand of Mary, Duchess of Burgundy, but Edward vetoed the proposal. Later he was accused of compassing the death of the king, was attainted and condemned, and is traditionally reported to have drowned himself in a butt of wine in the Tower of London.

GEORGE, Prince of Denmark: b. 1653; d. 1708. He was son of King Frederick III, and husband of Queen Anne of England. He sided with William of Orange in the Revolution of 1688, and received the title of Duke of Cumberland. Later he became lord high admiral, a post for which he was quite unfitted.

GEORGE I (George Lewis), king of Great Britain and Elector of Hanover: b. Hanover, Germany, 28 March 1660; d. Osnabrück, 12 June 1727. He was the son of the Elector Ernest Augustus, by Sophia, daughter of Frederick, elector palatine, and granddaughter to James I. In 1682 he married his cousin, Sophia Dorothea, daughter of the Duke of Celle. The union was not a happy one. George I was both a faithless and a jealous husband, and when his wife, who was guilty of some imprudences, brought on herself the suspicion of carrying on an illicit intrigue with Count Königsmark, he caused her to be imprisoned and kept her in confinement for the rest of her life. The offspring of the marriage were George, Prince of Wales, afterward George II, and Sophia, the mother of Frederick the Great. In 1698 he succeeded to the electorate, and in this succession was joined in the alliance against France. The command of the imperial army was conferred upon him in 1707, but owing to jealousies among his confederates he resigned the command at the end of three campaigns. At the Peace of Rastadt Louis XIV recognized the electoral dignity in the house of Lunenburg, as he had already by the Treaty of Utrecht recognized the succession of the same house to the throne of Great Britain, which event took place on the death of Anne in 1714, when the elector was in the 55th year of his age. His reign in England was disturbed first by a rising in 1715 of the Scottish Jacobites in favor of the son of James II, and afterward by wars with Spain, undertaken first in conjunction with Holland and France (the Triple Alliance of 1717), afterward in addition with Austria (the Quadruple Alliance of 1718), with the view of checking the schemes of the Spanish minister Alberoni. The bursting of the South Sea Bubble in 1720 caused an acute financial crisis. George I was plain and simple in his tastes and appearance; he had a high personal courage; he possessed much natural prudence and good sense, and his management of his German dominions, to which he showed more attachment than to his English dominions, was able. His preference for Hanover and the greed of his German mistresses and favorites made him unpopular in England. His inability to speak English made him unable to preside over his council of ministers and led to the cabinet system of government in Great Britain. Consult Coxe, 'Life of Walpole' (1808); Wright, 'England Under the House of Hanover' (1848); Thackeray, 'The Four Georges' (1860); Melville, 'The First George in Hanover and England' (1908).

GEORGE II (George Augustus), King of Great Britain, son of George I: b. Hanover, 10 Nov. 1683; d. London, 25 Oct. 1760. He married in 1705 Caroline of Bradenburg-Anspach. In 1708, then electoral prince of Hanover, he distinguished himself under the command of Marlborough and fought at Oudenarde and Dettingen. He came to England with his father at the accession of the latter and was created Prince of Wales. He was made regent during the king's visit to the Continent in 1716, but a political difference ensuing, he lived some time estranged from the court. This breach was finally adjusted and in 1727 he succeeded to the throne. He inherited in full force the predilection of George I for Hanover; and the same system of politics and the same ministers continued to govern the nation after his accession as before it. In the earlier part of his reign, during the greater part of the ministry of Walpole, the neutrality of England was preserved during the wars on the Continent. In 1739 the depredations committed by the Spaniards in America on the commerce of England led to war, which brought about the resignation of Walpole in 1742. England next took part in the war of the Austrian Succession, in which George II himself shared, being present at the battle of Dettingen in 1743. His reign is also memorable on account of the second Jacobite rising in Scotland in 1745–46, headed by Prince Charles Edward. In 1755 the disputes between Great Britain and France in relation to their respective boundaries in Canada produced hostilities in that country, and the Seven Years' War broke out the following year. The events of this war, in which the principal powers of Europe became engaged, raised Great Britain to a pinnacle of power under the able auspices of Pitt (first Earl of Chatham), whose accession to power was extremely distasteful to the king and was strenuously resisted by him, but who yielded him his confidence wholly when it was once gained. George II was a prince of very moderate abilities, parsimonious and wholly regardless of science or literature; hasty and obstinate, but honest and open in his disposition. His queen, the cultivated and well-informed Caroline, acquired a great ascendency over him, which did not, however, prevent some of the irregular attachments so common with royalty. George II was the last British sovereign to appear in action. He founded the University of Göttingen in 1734 and was the patron of Handel. Consult Hervey, 'Memoirs of the Reign of George II' (1854); Walpole, 'Memoirs of the Last Ten Years of the Reign of George II' (1822–46); Lucas, 'George II and His Ministers' (1910); Schmucker, 'History of the Four Georges' (1860); Thackeray, 'The Four Georges' (1860); Jesse, 'Memoirs of the Court of England from the Revolution of 1688 to the Death of George II' (1843); Wilkins, 'Caroline the Illustrious' (1904).

GEORGE III (George William Frederick), King of Great Britain: b. London, 4 June 1738; d. Windsor, 29 Jan. 1820. He was the eldest son of Frederick, Prince of Wales, by the Princess Augusta of Saxe-Gotha. On the death of his father in 1751, his education was entrusted to the Earl of Harcourt and the bishop of Norwich; but the formation of his opinions and character seems to have been materially influenced by the maternal ascendency of the princess dowager, who was principally guided by the counsels of the Earl of Bute. George III, the first of his house to be born and reared in England, who had been previously created Prince of Wales, ascended the throne on the demise of his grandfather, George II, being then in his 23d year. In the following year he married the Princess Charlotte Sophia of Mecklenburg-Strelitz, a union which in its result operated materially on the domestic character of this reign. In 1763 the Seven Years' War was concluded by the Peace of Paris under the ministry of Lord Bute. In 1764 George Grenville, who had become premier by the retirement of the Earl of Bute, began those measures in relation to the American colonies, the consequences of which proved so momentous; and the Stamp Act was passed the following year. About the same time, in consequence of some appearances of the mental derangement of the king, a bill was passed to enable his majesty to appoint the queen or any of the royal family residing in England guardian to his successor and regent of the kingdom. In 1766 the Rockingham administration repealed the American Stamp Act; at the same time passing a declaratory act asserting the right of taxing the colonies. The Rockingham cabinet was dissolved 30 July 1766, and succeeded by one formed by Pitt, now Earl of Chatham. In 1768 Lord Chatham, disgusted with the conduct of his colleagues, resigned the privy-seal and was succeeded by Lord Bristol. The same year was distinguished by the return of John Wilkes for Middlesex and the popular tumults attendant upon his imprisonment and outlawry. In 1773 the discontent in America burst into an open flame, and a royal message, in the commencement of the session of 1774, called on Parliament to maintain the English supremacy. Notwithstanding the subsequent loss of an empire, George III, by the steadiness with which he put down the coalition administration, acquired a degree of popularity which never afterward entirely deserted him. The smooth course of the early years of the administration of Pitt materially added to this disposition, which exhibited itself very strongly when the constitutional malady of the king again displayed itself in 1789, and still more upon his subsequent recovery. In reference to the French Revolution, and the important contests which arose out of it, it is sufficient to remark that George III zealously coincided in the policy adopted by his administration. A similar observation will apply to the domestic and Irish and Indian policy of the Pitt cabinet; as also to the transactions connected with the Irish rebellion. George III was immovable in his opposition to the demands of the Irish Catholics, and, seconded by the influence of the Church and the popular feeling, was enabled to eject the Fox and Grenville administration, which succeeded on the death of Pitt. The proceedings of the Perceval administration, until the final retirement of the king in 1810, need not be detailed here; while the insanity of the monarch renders the interval which elapsed from his retirement to his death a blank in his biography. George III possessed personal courage and steadiness of character in a high degree, but his aspirations after real kingship and personal rule had disastrous consequences. Of a plain, sound, but not enlarged understanding, he acted upon his convictions with sincerity. His tastes and amusements were plain and practical. Literature and the fine arts engrossed but a small share of his attention, and hunting, agriculture (he was half-derisively known by his subjects as "Farmer George"), mechanical contrivances and domestic intercourse, seem to have chiefly occupied his leisure. Religious, moral, temperate and somewhat parsimonious, the decorum of his private life was always exemplary. His deportment both as a father and a husband, according strictly with the national notions of propriety, rendered him and the queen a constant theme of praise; and the throne was regarded as a pattern in respect to conjugal duties. Consult Walpole. 'Memoirs of the Reign of George III' (1894); Massey, 'History of England During the Reign of George III' (1855); 'Grenville Papers' (ed. by Smith, 1852); Lecky, 'History of England During the 18th Century' (1878–90); Trevelyan, 'George III and Charles Fox' (1912).

GEORGE IV (George Augustus Frederick), King of England: b. London, 12 Aug. 1762; d. Windsor, 26 June 1830. He was the son of George III and the Princess Charlotte of Mecklenburg-Strelitz. His dissipated life, his extravagance, his marriage with a Roman Catholic, Mrs. Fitzherbert (21 Dec. 1785), in breach of the Royal Marriage Act of 1782, and whom he afterward repudiated and shamelessly deserted, and his connection with the most prominent members of the Opposition, alienated from him the affection of his father and the esteem of the nation. In 1795 he consented, on condition of the payment of his debts, to marry the Princess Caroline of Brunswick, but he soon began to treat her with neglect, and after the birth of their daughter, Charlotte Augusta, abandoned her. (See Caroline Amelia Elizabeth). On 3 Feb. 1811, he was appointed regent, with limited powers, on account of the king being attacked the previous year by a repetition of the mental malady to which he was subject. The Whigs, his former friends, now hoped to come into office, but the prince showed a sudden change of sentiments, and maintained the Perceval ministry in power. The distress caused by the interruption of the demand for manufactures and the high price of

GEORGE V

the means of subsistence after the general peace of 1815, occasioned great discontent among the people, and the violent measures adopted by the government increased the unpopularity of the regent, upon whose life an attempt was made in 1817, when he was going to open the session of Parliament. In 1820 he became king, on the death of George III. In February 1827 Canning became head of the government. The most important event after his attaining the throne was the passing of the Catholic Emancipation Act by the Wellington ministry, in 1829, and to which he was strongly opposed. During his reign the Crown suffered not only a serious diminution in power but its personal hold on the people sank low. George IV left no descendants, his only daughter, the Princess Charlotte, wife of Leopold of Saxe-Coburg, having died childless in 1817. He was succeeded by his brother William, Duke of Clarence (William IV). Consult McCarthey, 'History of the Four Georges and of William IV' (1884–1901); Thackeray, 'The Four Georges' (1860); Croly, 'Life of George IV' (1830); Lady Bury, 'Diary of the Times of George IV' (1838); Huish, 'Memoirs' (1830); Fitzgerald, 'Life of George IV' (1881); Melville, 'The First Gentleman in Europe' (1906).

GEORGE V, King of Great Britain and Ireland, Emperor of India: b. Marlborough House, London, 3 June 1865. George Frederick Ernest Albert is the second son of the late King Edward VII and the Dowager Queen Alexandra, daughter of the late King Christian IX of Denmark. He married, as Duke of York, 6 July 1893, Her Serene Highness, Princess Victoria Mary of Teck, his second cousin once removed. Their Majesties have six children: (1) Prince Edward Albert, Prince of Wales, heir apparant to the crown, b. 23 June 1894; (2) Prince Albert Frederick, b. 14 Dec. 1895; (3) Princess Victoria Alexandra, b. 25 April 1897; (4) Prince Henry William, b. 31 March 1900; (5) Prince George Edward, b. 20 Dec. 1902; (6) Prince John Charles, b. 12 July 1905. The king has three sisters living: Princess Louise (Princess Royal), widow of the late Duke of Fife; Princess Maud, wife of Haakon VII, King of Norway, and the Princess Victoria, who is unmarried. The late Queen Victoria, grandmother of the king, was a descendant of the House of Hanover, the 6th sovereign in succession of that dynasty.. By her marriage in 1840 to Prince Albert of Saxe-Coburg and Gotha, the House of Hanover came to an end and the dynasty became the House of Saxe-Coburg and Gotha, with the family surname of Wettin. The European War of 1914 produced a strong revulsion of sentiment throughout the British Empire against German names. Reflecting public sentiment, King George issued a proclamation on 17 July 1917, declaring that "We, having taken into consideration the Name and Title of Our Royal House and Family, have determined that henceforth Our House and Family shall be styled and known as the House and Family of Windsor," and to "relinquish and discontinue the use of all German Titles and Dignities." The name was happily chosen, for Windsor has been associated longer than any other royal residence with the lives and fortunes of the kings and queens of England. Windsor Castle dates back to William the Conqueror (1066), the founder of the House of Normandy; for nearly 1,000 years it has been the home of British sovereigns.

As already mentioned, King George is the second son of King Edward. The eldest son, the Duke of Clarence, was 17 months older and, consequently heir presumptive to the throne, the father being then Prince of Wales and heir apparent. The two boys entered the navy together as cadets in 1877 and spent two years on the *Britannia*. They were then transferred to the *Bacchante* and made a voyage round the world. Prince George was promoted midshipman in 1880, sub-lieutenant in 1884 and, after passing the necessary examinations, rose to lieutenant in 1885. After serving on various ships he received his first command, a torpedo-boat, for the naval manœuvres in 1889. In 1890 he commissioned a first-class gunboat and served a year on the North American station. Returning in 1891, he was promoted commander and took part in manœuvres in command of a cruiser. He was definitely committed to a seafaring career when the death of his brother in 1892 placed him in direct line of succession. For a time he continued in the navy, became captain in 1893 and commanded H. M. S. *Crescent* as late as 1898. By that time he was an Elder Brother and Master of the Corporation of Trinity House, a bencher of Lincoln's Inn, LL.D. of Cambridge and a Fellow of the Royal Society. He later became an admiral of the fleet, a field-marshal in the army and colonel of numerous regiments. Shortly after the death of Queen Victoria he made a tour of the British Empire and opened the first Parliament of the Commonwealth of Australia. After the death of King Edward (6 May 1910) he was crowned in Westminster Abbey, 22 June 1911 and in the same year went to Delhi with the queen and was crowned emperor of India. No British monarch every came to the throne with a wider knowledge of the world in general and of the empire in particular than George V; he was also the first king of England since 1743 to join his troops in the field. During the European War he crossed over to France on several occasions; from one trip he was brought home on a stretcher, having been injured by his horse falling on him. Both he and the queen have devotedly applied themselves to the special calls of the hour, inspiring people and fighting men, and comforting the wounded. His connection with army and navy is close and personal, not limited by mere titular ties.

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GEORGE I, King of Greece; title, King of the Hellenes: b. Copenhagen, 24 Dec. 1845; d. Salonika, 18 March 1913. He was second son (Prince William) of the king of Denmark. In 1863 he was elected king by the Greek National Assembly. In 1867 he married the Princess Olga, a niece of the Russian tsar. He ruled during a critical period in Greek history, was pan-Hellenic in his policy and had just emerged from a successful war with Turkey, waged between 1911–13, when he was assassinated by a drunken Greek degenerate. He was succeeded by the crown prince, who ascended the throne as Constantine I.

GEORGE, Greek prince, 2d son of George I, King of the Hellenes: b. Corfu, Ionian Islands, 24 June 1869. While traveling in Japan, in 1891, with his cousin, the grandduke (afterward Nicholas II) of Russia, he rescued the latter from death at the hands of a religious fanatic. He married in 1907 Princess Marie Bonaparte.

GEORGE V, King of Hanover: b. Berlin, 27 May 1819; d. 12 June 1878. He was son of Ernest Augustus. He ascended the throne of Hanover in 1851; in the war between Prussia and Austria in 1866 sided with the latter, and the same year was removed by Prussia, which annexed the kingdom on 20 September. As ex-king he assumed the titles of Duke of Cumberland and Teviotdale (Great Britain) and Earl of Armagh (Ireland).

GEORGE II, Duke of Saxe-Meiningen: b. Meiningen, 2 April 1826; d. 25 June 1914. He was educated at Bonn, received the commission of major in the Prussian cuirassier-guards, succeeded upon the abdication of Duke Bernhard, his father, in 1866, and served in the Franco-German War as Prussian general of infantry. Assisted by the manager Cronegk he did much to improve German drama. His son, Prince Ferdinand, was killed at the siege of Namur, 23 Aug. 1914.

GEORGE, surnamed «THE BEARDED,» Duke of Saxony: b. 27 Aug. 1471; d. 17 April 1539. He was the son of Albert the Brave, the founder of the Albertine line of Saxony, and succeeded, in 1500, to the hereditary dominions of the Albertine house. Later on he became involved in the turmoils of the Reformation period. He was not at first wholly hostile to reform, but thought that it could be better effected by means of papal edicts than by the revolt of Luther. Accordingly he became embittered by the uncompromising tone of Luther's later writings, and endeavored to suppress the Reformation in his dominions by violent measures. These, however, were unsuccessful, and in 1539, on the accession of his brother Henry, who was a Protestant, the Reformation was introduced into the dominions of the Albertine house of Saxony.

GEORGE, King of Saxony: b. 1832; d. 15 Oct. 1904. In 1846 he entered the army and in 1849–50 studied at the University of Bonn. In 1866 he fought against the Prussians and commanded a corps in the Franco-Prussian War of 1870–71. In June 1902 he succeeded to the throne on the death of his brother Albert. He was succeeded by his son Frederick Augustus.

GEORGE, David Lloyd, British statesman: b. at 5 New York Place, Chorlton-on-Medlock, Manchester, 17 Jan. 1863. His father, William George (born 1820), who came of farming stock in South Wales, married Elizabeth Lloyd (died 1896), daughter of David Lloyd of Llanystmdwy, North Wales. He was a Unitarian schoolmaster and held schools in Lancashire; two of his children were born in Manchester. Under the strain of city life, his health began to fail; he took a farm at Haverfordwest, in Pembrokeshire, and there succumbed to pneumonia 7 June 1864. In her distress the widow appealed to her bachelor brother, Richard Lloyd, the village shoemaker of Llanystmdwy, and he invited her to bring her family to share his home. Richard Lloyd (d. 1917) was a man of strong personality, who, in addition to his ordinary avocation, ministered to the local congregation of the Church of Christ or the Disciples — the community to which President Garfield was attached — and into fellowship with which the future prime minister was in due time baptized.

Lloyd George's upbringing was Spartan in its simplicity, and the environment of his youth, raised as he was on the edge of the poverty line, is significant of much in his outlook on the world. His uncle's «home was comfortable, but thrifty and pinched. Our bread was home-made; we scarcely ate fresh meat, and I remember that our greatest luxury was half an egg for each child on Sunday mornings.» But if there was barely a sufficiency to eat, the intellectual and spiritual atmosphere was both nourishing and stimulating. His uncle's shop was the rendezvous for the village, «the centre of gossip, of disputation, of all the conflicts of religious and political creeds.» The atmosphere was that of militant non-conformity; Church and Squire were the powers that be, and they were allied: to the one non-conformists — the great majority of the Welsh people — were compelled to pay tithes, and by the other his tenants were expected to support the political candidate for Parliament to whom he gave support, or eviction might be the result. It is told of Lloyd George that in school he headed a revolt against the Ash Wednesday parade of the village school — in which was taught the Church creed and catechism compulsorily — with such effect that it was afterward abandoned. In order that he might pass the entrance examination for the Incorporated Law Society, he and his uncle learned French together, by laboriously spelling out of an old French dictionary and out of a grammar the rudiments of the language. The examination passed, he was in his seventeenth year articled to a solicitor at Portmadoc. He then began to contribute articles to the native Welsh press, and he served in the volunteers. In 1884 he was admitted a solicitor; and so poor was he that he could not afford three guineas for his robes, and had to wait till he got a few cases before he could meet this outlay. He began practice at Criccieth — then and now his home — and the following year opened an office at Portmadoc. As a member of the Portmadoc Debating Society he steadily cultivated the talent for platform oratory which from his boyhood he was seen to possess, and came to be almost as much at his ease in English as in his native Welsh. In 1886 he organized the Farmers' Union, and became secretary to the Anti-Tithe League of Carnarvon. His practice as a solicitor began to grow rapidly; he acquired a reputation as a reliable, industrious and astute pleader, and he was not in the least daunted by the frowns or illwill of the local magnates who filled the magistracy. In 1888 the principality was thrown into a turmoil by the Llanfrothen Burial Case. Under the Morgan Burials Act of 1880, non-conformists were permitted, on formal notification to the parish clergyman, to bury their dead in the parish churchyards of Wales, and with their own rites. The rector of this parish endeavored to defeat the act in the case of the interment of a quarryman who had de-

RT. HON. DAVID LLOYD GEORGE

Prime Minister of Great Britain

sired to be buried beside his daughter; and he claimed the right to select the spot where the man should be buried. Lloyd George advised that the rector's action was illegal, the gates of the churchyard were forced, and the interment took place in accordance with the quarryman's last wishes. The case was fought out in the courts, and in the end the young solicitor's action was fully vindicated. In the same year he married Miss Maggie Owen, of Mynydd Edynfed Fawr, Criccieth. Four children — two sons and two daughters — have been born of the union.

In 1888 Mr. Lloyd George was chosen Liberal candidate for the Carnaroon Burghs, and was returned at a bye-election in 1890 by a narrow majority on a platform the chief plank in which was Welsh Nationalism. He did not at first take much part in the debates; but in 1894 led a revolt against the Rosebery ministry because Welsh Disestablishment was not given a place in the government's legislative program for the session. His rise into prominence dates from the South African War. He was traveling in Canada when in September 1899 the crisis approached in the relations between the British and the Transvaal governments. He hurried home, and on the outbreak of war at once took up a position of strong antagonism to the government's war policy, and became the real leader of what was termed the "pro-Boer" section of the Liberal party. It required courage to face the hostility of popular audiences when the war spirit was running high; and at a meeting in Birmingham — the stronghold of the Colonial Secretary, Mr. Chamberlain — his platform was stormed, and he was compelled to make his exit. He specially singled out Chamberlain for attack, and was by no means scrupulous in the line he took, as when he charged that the Colonial Secretary had brought on the war in order to fill the pockets of his relations; but his boldness and pertinacity began to tell, and from that time he was a force to be reckoned with. He took a prominent part in the opposition to Balfour's Education Act of 1902 and strongly opposed Chamberlain in his tariff reform campaign. On the accession of the Liberals to power in 1905 he was invited to become president of the Board of Trade (11 December). To this time he had been known chiefly as a platform speaker with a gift for repartee and as an adroit and effective debater. As president of the Board of Trade he applied himself assiduously to the duties of his office, spoke little, and presently began to manifest qualities hitherto held in the background — skill in constructive legislation, open-mindedness and tact in the handling of men. The Patents Bill of 1907 and the Port of London Bill, and his adroit handling of the railway strike and the cotton trade dispute, were proofs that a new Lloyd George had arisen. On the death of Sir Henry Campbell-Bannerman and the accession to power of Mr. Asquith, Mr. Lloyd George succeeded the latter as Chancellor of the Exchequer (12 April 1908). In the following month he passed the Old Age Pensions Bill, which had been framed by his predecessor. His first budget, introduced 29 April 1909, gave rise to a prolonged and bitter controversy. It provided, among other things, for heavy increases on the income tax, and — an entirely novel provision — for a tax of 20 per cent on the unearned increment in land values — the moneys thus provided to be devoted to social legislation. The budget was received with enthusiasm by advanced Liberals; but it was strenuously opposed by powerful interests. The Chancellor conducted a vigorous campaign on behalf of his budget, in which he gave full rein to his wit and homely eloquence; but he did nothing to reconcile his opponents beyond hitting them on the head, a notable example of his method being furnished in the famous Limehouse oration. So strong was the opposition that the House of Lords was emboldened to take the dangerous and unconstitutional course of rejecting the Finance Bill introduced to give effect to the resolutions of the budget. There is no reason to suppose that the Chancellor was anything else than completely satisfied with the action of the House of Lords; for in the result it had signed its own death warrant. The Prime Minister promptly accepted the challenge, Parliament was dissolved, and — with the assistance of Nationalists and Laborists — the government was again returned to power and the disputed budget put through. Meantime the Parliament Bill had been introduced providing for the effective curtailment of the powers of the Upper Chamber — a measure which was passed only after the verdict of the country had again been taken and after a political deadlock which ended when the assent of the Crown was announced to the creation of a sufficient number of peers to force the measure through the House of Lords in the event of that assembly proving obdurate. In 1911 the Chancellor passed the National Insurance Act — a far-reaching but somewhat hastily constructed and insufficiently deliberated measure making provision for wage-earners. In 1913 a foolish investment of his in the shares of the American Marconi Company, with the parent company of which the British postoffice had contracts, laid him open to personal attack and was the subject of parliamentary inquiry. During the Home Rule controversy in the years immediately preceding the Great War, Mr. Lloyd George's influence was cast on the side of moderating counsels.

When Great Britain, following on the violation of Belgian territory, declared war on Germany on 4 Aug. 1914, eyes were naturally turned to Lloyd George, and there were not a few who expected him, owing to what were regarded as his pacifist tendencies, to resign from the Cabinet; but his speech in the Queen's Hall on 19 September showed that he was wholeheartedly in favor of its prosecution. As Chancellor of the Exchequer he took prompt and wise measures to maintain financial stability. Right from the outset of the war he appeared to realize, better than others in the Cabinet, the magnitude of the task that confronted the Allied nations, and early began to manifest some impatience with the slowness with which munitions were being supplied — especially high-explosive shells. Partly as a result of this — combined with the attacks of the Northcliffe press on Lord Kitchener's administration of the war office — he was, on the formation of the Coalition Ministry in May 1915, appointed Minister of Munitions. This task called for a combination of qualities; and under his direction a network of arsenals soon covered the land, new workmen were trained, and women enlisted into the service. Not the least difficult of his tasks was in inducing the trade unions to forego — for the duration of the war at least — the exclusive and "ca' canny" policy dear to the heart of the British workman, in order that by dilution of labor the claimant needs of the nation might be met; and where his stirring appeals had no result, he succeeded in shaming them into acquiescence. Realizing the need of men, he supported from the outset, and forced to a head, the movement for compulsory national service. On the death of Lord Kitchener (June 1916) he became Secretary for War.

A crisis in his relations with the head of the government in December 1916 resulted in the accession to power of Mr. Lloyd George as Prime Minister. On land the war was not going well with the Allied nations; Rumania was being overrun and Bucharest had fallen; and there was a strong feeling in England — fanned into flame by the Northcliffe press — that Mr. Asquith was too inert, and that the method of conduct of the war on the civilian side would require to be drastically overhauled if satisfactory results were to be obtained. On 1 December Mr. Lloyd George, under threat of resignation, urged on his chief the necessity of placing the direction of the war in the absolute control of a war committee of four members, of which he (the Prime Minister) should not be one. After some negotiation and a modification of the original proposal, Mr. Asquith declined to accede, and the Chancellor resigned. As the Unionist members of the Cabinet supported Lloyd George, and his administration was therefore doomed, the Prime Minister placed his resignation in the hands of the king; and after the Unionist leader, Mr. Bonar Law, had declined to form a government, Mr. Lloyd George was on 6 December entrusted with the task of forming an administration. He began by a revolution. Instead of following the traditional British custom of forming his government exclusively from men holding seats in Parliament, he gave some of the most important portfolios to recognized experts who had had no political or parliamentary experience and had seats in Parliament provided for them. He found places in his inner war cabinet for Mr. Arthur Henderson, one of the labor leaders, and for two of his strongest opponents of other days — Lord Curzon and Lord Milner. Indeed it may with truth be said that since his accession to power his foes have been chiefly those of his own household. His government has been called to face an extraordinary series of crises, in the surmounting of which he has shown great resourcefulness and audacity; and he had the misfortune to assume control just before the defection of Russia. He is regarded in Great Britain and the Dominions as the incarnation of the democratic spirit; and despite certain readily understandable limitations, such as lack of broad culture and occasional inaccuracy of statement, his flaming oratory, quickness in seizing the salient points of any situation, driving force, enthusiasm and dauntless courage, which mounts the higher when the tide of disappointment or misfortune rises, have braced the British people to dare all and to surrender all that victory may be won, and have proved an asset of incalculable value to all the Allied nations. And not the least of his services has been in securing unified command of the Entente armies, the fruits of which began to be gathered in the series of military successes that crowned the autumn of 1918.

Consult Dilnot, 'Lloyd George: the Man and his Story' (1917); 'Life' by Du Parcq (4 vols., 1912); Evans and Hughes, 'From Village Green to Downing Street'; B. G. Evans, 'The Life Romance of Lloyd George' (1916); and 'Lloyd George and the War,' by an Independent Liberal (1917). His earlier war speeches have been published under the title 'From Terror to Triumph' (1915).

D. S. DOUGLAS,
Editorial Staff of The Americana.

GEORGE, Grace, American actress: b. New York 1880. In 1894 she made her first public appearance in 'The New Boy.' In 1899 she starred in 'The Princess Chiffon' and in 'Her Majesty' (1900). Subsequent triumphs came in 'Under Southern Skies' (1902); 'Frou-Frou' (1903); 'Pretty Peggie' (1904) and 'The Two Orphans' (1904). As Cyprienne in 'Divorçons' she achieved a splendid success in both London and New York in 1907 and in the subsequent revival of this piece in 1913. Other plays in which she appeared were 'Sylvia of the Letters' (1909); 'A Woman's Way' (1909); 'Just to Get Married' (1912); 'The Earth' (1912); 'Half an Hour' (1912); 'The Truth' (1914). Consult Winter, William, 'The Wallet of Time' (2 vols., New York 1913).

GEORGE, Henry, American political economist: b. Philadelphia, 2 Sept. 1839; d. New York, 29 Oct. 1897. In boyhood he made a voyage before the mast to India; made his way to California as a sailor in 1858 and from thence to Vancouver Island; returning to California, worked at his own trade of printer and other employments, until he became a reporter for the San Francisco *Times*, and in 1867 the editor of the same paper. While in California he became deeply impressed with the evils of land monopoly as evidenced by the fortunes accruing to the holders up of the soil, and this set a stamp on his after career. In 1871 he published 'Our Land and Land Policy' in which he advocated the single tax theory, later developed more fully in 'Progress and Poverty' (1879). In this latter work, he not only explained his policy of land taxation (see SINGLE TAX), but also attacked the doctrine of Malthus (q.v.), and the "wages fund" theory, advancing the theory that the wages of labor are paid out of the value that the laborer creates, not from a "fund" of capital. The book did not at once attract much attention, and was first widely noticed in England; later attaining great popularity in this country. George visited England in 1880–81, and on his return settled in New York, where he devoted his time to writing, and agitation and organization for the single tax movement. In 1886 he was nominated for mayor of New York by the United Labor party, but was defeated, though receiving over 67,000 votes. In 1897 he was again nominated for mayor and took an active part in the campaign, but died before election day. His works, besides those already mentioned, include 'The Irish Land Question' (1881); 'Social Problems' (1883); 'Property in Land'; 'The Condition of Labor'; 'Protection or Free Trade' (1886). His complete works were published in 10 volumes in New York in 1904. Consult George, 'Life of Henry George' (New York 1905).

GEORGE, Henry, American legislator and economist: b. Sacramento, Cal., 3 Nov. 1862; d. Washington, D. C., 14 Nov. 1916. He was a son of Henry George, the political economist. He was educated in the public schools, and entered a printing house at 16. He entered on a journalistic career in 1881; accompanied his father as secretary on a lecture tour of Great Britain in 1883; and on his father's sudden death during the New York mayoralty campaign of 1897, he was nominated to succeed his father as candidate of the Jeffersonian party, but was defeated at the polls. In 1906 he was correspondent in Japan for a syndicate of newspapers and magazines, and in 1909 for *Collier's Weekly*. He campaigned for Lloyd-George in the British general election of 1909. He was elected to the 62d Congress (1911–13) from the 17th New York District, and to the 63d Congress 1913–15 from the 21st New York District. He published 'Life of Henry George' (1900); 'The Menace of Privilege' (1905); 'The Romance of John Bainbridge' (1906). His last years were spent in lecturing and writing on economic subjects.

GEORGE, James Zachariah, American politician: b. Monroe County, Ga., 20 Oct. 1826; d. Mississippi City, Miss., 14 Aug. 1897. He fought in the ranks in the Mexican War, afterward studied law, became brigadier-general in the Confederate army during the Civil War, and in 1879–81 was chief justice of the Supreme Court of Mississippi. In 1880 he was elected to the United States Senate as a Democrat, and in 1886 and 1892 was re-elected. As a jurist he aided in drafting the present State constitution of Mississippi, and in the Senate he was well known as an orator.

GEORGE, Stefan (STEPHAN ANTON GEORGE), German poet: b. near Bingen on the Rhine, 12 July 1868, is the accepted head of a group of young poets who attempted to establish a school of new lyricism which should consciously, almost polemically, break with the old traditions, especially of artificial popular poetry, of naturalism and of the reigning symbolism. George could not create new meters, nor new rhymes, but his independent use of these and his originality are always in evidence. He is seldom reminiscent and never an imitator.

A selection of his earliest poems, treating in fairly original, carefully polished form the common subjects of love and loss, fate, spring, home, faith, the transience of things, is now accessible in 'Die Fibel' ('The Primer,' 1901). Of greater power and intensity of feeling are the 'Hymns, Pilgrimages, Algabal' ('Hymnen Pilgerfahrten Algabal') with their «pilgrimage» toward artistic perfection, revealing hopes, fears, disappointments and discouragement. The lyric story of the Syro-Roman Imperial degenerate Elgabolus, with its mixture of Oriental splendor and Roman tyranny, crazy jumble of mad religious superstitions, of sloth, crimes, suicidal impulse, love of life, lusts, pleasures, and the Imperial realization of the vanity of life, has even been taken to symbolize the history of that lyric poetry with which the new school are done. This «nightmare,» which George seems to call it in the last poem of the book, has probably more admirers than any of his other works.

This æsthetic pilgrimage is continued in the 'Books of the Shepherds and of the Eulogies, of Sagas and Songs of the Hanging Gardens' (Die Bücher der Hirten und Preisgedichte, Der Sagen und Sänge und der hängenden Gärten) (1895) which pass in review primitive, Hellenic, mediæval and modern man. 'The Year of the Soul' ('Das Jahr der Seele,' 1898) treats the relations of man and woman with the seasons as a background, excepting spring, as if Heine and other poets had exhausted that field. In 'The Carpet of Life and the Songs of Dream and Death' ('Der Teppich des Lebens und Die Lieder von Traum und Tod mit einem Vorspiel') the poet's «Angel» plays a rôle like that of Virgil and Beatrice to Dante.

The 'Seventh Ring' ('Der siebente Ring') contains many poems passed over in other volumes, and good odes. 'Der Stern des Bundes' (1913) was the last important work before the European War of which it was curiously prophetic. Finally, George's translations (Übertragungen) of his spiritual kin Rossetti, Swinburne, Verhaeren, Verlaine, Mallarmé, D'Annunzio and others are excellent. Consult Goldschmidt, K. W., in *Literarische Echo* (1905–06); Meyer, R. M., in *Deutsche Literatur des XIX Jahrh.*; Zwymann, Kuno, 'Das Georgesche Gedicht' (2d ed., Berlin 1904).

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GEORGE, W. L., English author: b. Paris, 20 March 1882. He was educated in Paris and served in the French army. He was educated successively as an analytical chemist, an engineer, a barrister, a soldier and a business man, and having proved a failure at all these took to journalism about 1907. He has contributed to most London publications on topics ranging between the art of the troubadours and the finance of railways. He is especially interested in feminism and its subsidiaries: marriage and divorce problems, fashions, votes for women, and sex questions generally. In politics he is an aggressive pacifist, an opponent of the idea of nationality and a republican (this latter subject to the view that the people should not be trusted but led). He has been special correspondent of various papers in France, Belgium and Spain. He wrote 'Engines of Social Progress' (1907); 'France in the Twentieth Century' (1908); 'Labor and Housing at Port Sunlight' (1909). He became convinced in 1909 that social and philosophic ideas are best spread through fiction and wrote 'A Bed of Roses' (1911); then followed 'The City of Light' (1912); 'Until the Daybreak' (1913); 'The Making of an Englishman' (1914); and 'The Second Blooming' (1916); the latter was one of the most successful novels of 1915, 10 editions of it being sold. He also wrote 'Woman and To-Morrow' (1913); 'Dramatic Actualities' (1914); 'Anatole France' (1915); 'Olga Nazimov' (1915) and 'The Stranger's Wedding' (1916).

GEORGE, William Reuben, American sociologist: b. West Dryden, N. Y., 4 June 1866. He received his education in the public schools and in 1880 settled in New York. From 1890 to 1894 he made a practice of taking numbers of boys and girls on a vacation during the summer months. From this he conceived the idea of a junior republican community in which the members would work for what they received, but would all have a voice in the management of the community. In 1895 the plan blossomed forth in «George Junior Republic,» at Freeville, N. Y. He originated also the social service prison reform method, which is being adopted by many State penal institutions. Although the invitations to public office have been numerous he has refused holding any such, wishing to devote his whole time to the development of the self-support and self-government idea among the youth of the country. See George Junior Republic.

GEORGE, Lake. See Lake George.

GEORGE, Order of Saint. See Garter, Order of the; Orders (Royal); *Russia, Bavaria, Hanover, Sicily, Great Britain.*

GEORGE-A-GREENE, The Pinner of Wakefield. A comedy written in 1595–96 and on slender evidence attributed to Robert Greene. It is founded on an old prose romance entitled 'The History of George-a-Greene' and a ballad, 'The Jolly Pinder of Wakefield with Robin Hood, Scarlet and John.'

GEORGE BARNWELL, or The London Merchant, a prose tragedy, dealing with bourgeois society, and written by George Lillo. It was produced at Drury Lane Theatre, 22 June 1731. Consult Cibber, Colley, 'Life of George Lillo.'

GEORGE OF CAPPADOCIA, sometimes called George the Arian, also George the Fuller of Cappadocia. His father was a fuller by occupation. The date of his birth is not known; d. Alexandria, Egypt, A.D. 361. He belonged to the Arian party in the Church, and is credited by the opposite party with having been a despicable parasite and vagabond, exceedingly corrupt, vile and ignorant. He was for a time a subaltern in the Commissariat Department of the army and embezzled funds and had to flee. He then became a low vagabond. Of his ignorance it was said by his enemies that he had «no knowledge of letters and still less of the Holy Scriptures.» The Emperor Constans favored the Arian party, and when an assembly of 30 Arian bishops met at Antioch in the year 356, George was sent to Alexandria to govern the Church and to see Athanasius. George was given a bodyguard of soldiers commanded by Sebastian, Duke of Egypt, who was a Manichæan. All sorts of sacred places were entered in search for Athanasius and a reign of terror ensued. Sixteen bishops are said to have been banished and others fled or submitted. The Alexandrians rose against George and he was obliged to fly from the city. Later he returned backed up by the authority of Constans. The pagans were his enemies because he had pillaged their temples. They arose against him and maltreated him. The next day they paraded him about the city on the back of a camel, and finally threw him and the animal upon a blazing pile of combustibles. His ashes were thrown to the winds and his house plundered. The Emperor Julian wrote to the rioters, condemning them seriously, but let them go without punishment. George had an extensive library which the Emperor Julian tried to recover. He may have been as bad a man as represented, but the fact that he owned a large library was certainly not in keeping with the claim that he was ignorant. All the writings that survive that time are from the pens of members of the other party, and were written in the white heat of partisanship. We shall probably never learn the exact truth concerning him.

GEORGE ELIOT. See Eliot, George.

GEORGE JUNIOR REPUBLIC, the community established (1895) near Freeville, N. Y., by William R. George (q.v.) as a method of reform in the treatment of dependent and delinquent boys and girls. The organization is that of a miniature village, in fact the whole principle of the Junior Republic is embodied in the following statement: The Junior Republic is a village, just exactly the same as any other village in the country. This means that it embodies the same social, civic and economic conditions. The one essential difference is the fact that its citizens reach their voting age when they are 16 instead of 21 years. Its operation has been successful. Students from all parts of the world have made pilgrimages to Freeville to see the little colony in operation. Originally it was designed to be used for delinquents only, but its scope has enlarged so that its citizenship is made up of boys and girls of all classes and conditions of society, in addition to those who have been delinquent. It is possible for the young people to learn a trade in this community, likewise prepare for college. The idea has extended to other States, and at the present time there are seven other republics in different parts of the United States. There is also a little commonwealth in England which is carried on in much the same manner. Many of the institutions in the country have adopted some of the Junior Republic ideas. Particularly is this true in some of the prisons.

GEORGE PEABODY COLLEGE FOR TEACHERS. See Peabody College for Teachers.

GEORGE SAND, zhôrzh'ę sänd. See Sand, George.

GEORGE OF TREBIZOND, noted Greek scholar: b. Crete, about 1396; d. 1484. His family belonged to Trebizond. He was invited to Venice by Francesco Barbaro and in that city became a teacher of rhetoric and philosophy. Subsequently he served as secretary to Pope Eugenius IV and later to Pope Nicholas V. At Rome his fame spread as a Greek scholar and translator. His work as translator was severely criticised by contemporary scholars. He was a follower of Aristotle in philosophy and was in frequent conflict with the Platonist, Gemistus Plethon. George's works include 'Rhetorica' (1470); 'Comparationes Philosophorum Platonis et Aristotelis' (1523). Consult Fabricius, 'Bibliotheca Græca' (Vol. XII, Hamburg 1790–1809), and Voigt, 'Die Wiederbelebung des Classischen Altertums' (2d ed., 2 vols., Berlin 1893).

GEORGE WASHINGTON UNIVERSITY, Washington, D. C. Founded in 1821 as Columbian College; by amendatory acts of Congress its name was changed in 1873 to Columbian University and in 1904 to The

George Washington University. It has colleges and schools as follows: Columbian College (academic), Teachers College, the College of Engineering and the Graduate School — all comprehended in the Department of Arts and Sciences — the Medical School, the Dental School and the Law School. Also it has affiliated with it the National College of Pharmacy and the College of Veterinary Medicine. It repeats morning instruction in the late afternoons, thereby meeting the needs of government employees and others holding salaried positions.

GEORGE'S CHANNEL. See SAINT GEORGE'S CHANNEL.

GEORGETOWN, capital of British Guiana, situated on the eastern side of the Demarara River, at its mouth, with the Caribbean Sea for a second frontage. The city covers an area of 1,200 acres. Nearly every building in the quarters devoted to private dwellings is isolated from its neighbor and surrounded by palms, shrubs, or forest trees. The streets cross each other at right angles; those which run north and south in some cases have long canals in the centre, beyond which are the roadways — the width of such streets being more than 100 feet. On Main (or High) street are situated the town-hall, Victoria law courts, police magistrate's office, Colonial Bank, Presbyterian church, Portuguese Roman Catholic church and the Methodist church. The public buildings, where the Court of Policy sits, and the Anglican cathedral are also in this section. Another fine street is the Brick Dam, the two rows of houses in which constituted the entire town of Stabroek before the colony was captured by the British. The finest building in the colony, the Roman Catholic cathedral, stands a short distance east of this street. The Royal Mail Company, with its fortnightly mail service, makes the port of Georgetown a terminus; boats of the French Compagnie Generale Transatlantique call monthly on the way to Cayenne; the Dutch Mail does the same when going to Surinam; and steamers of a Canadian line also call every fourth week. Vessels drawing more than 20 feet cannot cross the bar at the mouth of the river, and those of even lighter draught are obliged to wait for high water. A line of steamers subsidized by the government makes daily trips from Georgetown to Essequibo; three times a week a steamer runs to Berbice; twice a week up the Demarara and Berbice rivers; and there is fortnightly communication by boat with Morawhanna, the capital of the northwestern district. A railway also connects Georgetown with Mahaica, on the east coast. The West India and Panama Telegraph Company also puts the city and colony in communication with other countries. There are good street car and telephone services. The city water, brought from creeks 20 miles distant through the Lamah Canal, is chiefly valuable in case of fire; it is not sufficiently pure for household use. The city is lighted by gas and electricity. Municipal affairs are managed by a mayor and town council. The value of real property is nearly $8,000,000; the portion held by Europeans and Creoles (other than Portuguese) being valued at $4,611,575; the portion held by Portuguese at $1,938,370; by East Indians, $101,930; and by Chinese, $45,750. The tax-rate is usually 2 per cent per annum on the appraised value of private property. There is a well-equipped and trained fire brigade; nevertheless the precautions which have been taken failed to prevent very destructive fires (22 Dec. 1913; also in 1873 and 1896). Among the important institutions are the Royal Agricultural and Commercial Society, which has a library of over 17,000 volumes, and maintains reading-rooms, etc.; the Institute of Mines and Forests and the Chamber of Commerce. Of the newspapers, one is issued daily, and a number weekly, bi-weekly or tri-weekly. The port is regarded as healthful. There were two or three severe attacks of yellow fever half a century ago, but since that time the drainage has been improved, and the neighborhood of the wharves kept clean, and during the past 50 years only one serious outbreak has occurred. The number of inhabitants is given as 59,955. See GUIANA, BRITISH.

GEORGETOWN, city in the Straits Settlements. See PENANG.

GEORGETOWN, Colo., town and the county-seat of Clear Creek County, situated, at an altitude of 8,475 feet, in a valley in the Rocky Mountains, 52 miles west of Denver on Clear Creek and the Colorado and Southern Railway. It is the centre of an important silver district, and has also gold, lead, zinc and copper interests. The town is picturesque and healthful and enjoys some reputation as a summer resort. It has a park, public library, hospital and gas and electric-light plants. The water system is owned by the municipality. Pop. 1,950.

GEORGETOWN, Del., town and the county-seat of Sussex County, 40 miles south by east of Dover, on the Pennsylvania Railroad. It is situated in an agricultural district. The chief interest is the canning industry. Pop. 1,609.

GEORGETOWN, D. C., formerly a town in the District of Columbia; now included within the limits of Washington (q.v.), and sometimes called West Washington. It was at the head of Potomac navigation, and the port of entry for the District of Columbia.

GEORGETOWN, Ky., city and the county-seat of Scott County, 12 miles north of Lexington and 20 miles east of Frankfort, on the Frankfort and Cincinnati, the Cincinnati, New Orleans and Texas Pacific and the Louisville Southern railroads. It is in the heart of the "blue-grass" region, and the centre of an important stock-raising and agricultural districts. Flouring-mills, brick-works and other industries are also located here. Georgetown College (q.v.) is here situated. The "Royal Spring," which rises in the centre of Georgetown and furnishes about 200,000 gallons of water per hour, supplies the municipal water plant and affords the power for the street railway, an ice plant, a flour mill and other establishments. Georgetown was settled in 1776, incorporated in 1790 and received its charter in 1894. The government is administered by a mayor, chosen for four years, and municipal council, elected on a general ticket. Pop. 4,533.

GEORGETOWN, Ohio, village and the county-seat of Brown County, 42 miles east by south of Cincinnati and seven miles north of the Ohio River, on White Oak Creek and on the Cincinnati, Georgetown and Portsmouth, and the Ohio River and Columbus railways. It is the centre of an agricultural region, the growing of tobacco being an especially important industry. There are also some manufactures, and blue limestone is quarried in the vicinity. The village operates an electric plant. Pop. 1,580.

GEORGETOWN, Ontario, town and railway junction of Halton County, 25 miles west of Toronto, on Credit River and the Grand Trunk Railway. The water-power is excellent. There are paper-mills, knitting-machine manufactories, knitting and woolen factories and carriage works. Pop. 1,583.

GEORGETOWN, P. E. I., town and port on the eastern coast, the capital of King's County, by rail 39 miles east of Charlottetown. It has a fine natural harbor, is the chief winter port of the island, is a favorite summer resort and has a lobster packing industry. Pop. about 1,500.

GEORGETOWN, S. C., city, port of entry and county-seat of Georgetown County, at the head of Winyah Bay, 60 miles northeast of Charleston, on the Seaboard Air Line. The various streams entering the bay are navigable for an aggregate of 1,000 miles and make Georgetown the centre of an extensive agricultural area. Steamers connect the city with Charleston, Baltimore, New York and other points. Rice, shingles, turpentine, lumber, grain, fish, alcohol, and cotton are exported in large quantities. The annual port commerce is about $10,000,000, and the annual tonnage 500,000. It contains machine shops and foundries, bottling works, chemical and canning factories, saw mills, an alcohol factory and an ice factory. It has a chamber of commerce, nine building and loan associations and three banking institutions. The post office and customs buildings are worthy of notice, and there are several churches and schools. Georgetown was settled about 1700 and incorporated in 1805. It was the landing place of Lafayette on his first visit to the United States in 1784. The government is vested in a mayor, elected every two years, and a council elected at large. The waterworks are the property of the municipality. Pop. 5,530.

GEORGETOWN, Tex., city and the county-seat of Williamson County, 28 miles by rail north of Austin, on the San Gabriel River and on the Missouri, Kansas and Texas and the International and Great Northern railways. The surrounding region is agricultural and pastoral. Georgetown has cotton-gins, a cottonseed-oil mill and the planing-mills, and manufactories of plows, ice, harness and woodwork. Here are located mineral springs whose waters are similar to those of the well-known springs at Karlsbad, Germany. Georgetown is the seat of Southwestern University, an institution of the Methodist Episcopal Church, South, founded in 1873. Georgetown was settled in 1848, incorporated as a town in 1866, and chartered as a city in 1890; it is governed by a mayor and council, elected biennially. The electric-light and water systems are owned by the city. Pop. 3,096.

GEORGETOWN COLLEGE, Kentucky, a coeducational institution in Georgetown, founded in 1829. It is under the auspices of the Baptist denomination in Kentucky; reported at the close of 1916: Professors and instructors, 28; students, 371; volumes in the library, 14,000; productive funds, $310,000; grounds and buildings valued at $240,000; income, $40,000; number of graduates, 950.

GEORGETOWN INDIANS. See SALISHAN INDIANS.

GEORGETOWN UNIVERSITY, District of Columbia, an institution of higher education, under the direction of the Roman Catholic Church. The plan of the institution was undertaken as early as 1785 by the Rev. John Carroll, later first archbishop of Baltimore. In 1786 the corporation of clergymen in the chapter held at Whitemarsh, Md., adopted a series of resolutions directing the establishment of the institution and the erection of its first building. The year 1789 is generally considered the year of the foundation of the university, though students were not received until 1791. Upon the reorganization of the Society of Jesus in Maryland in 1805, the Georgetown College, as it was then called, was transferred to that society, under whose direction it still remains. In 1815 the university was empowered by act of Congress to confer any degree in the arts, sciences and liberal professions which are conferred in other colleges and universities, and, in 1833, the Holy See empowered the university to confer, in the name of the Church, degrees in philosophy and theology. The university is composed of the college; the school of medicine, organized in 1851 and including since 1901 a school of dentistry; and the school of law, organized in 1870. The college comprises three distinct departments, the graduate school, the undergraduate department and the astronomical observatory. A preparatory department is also connected with the university. The teaching of the university is guided by the principles of the Ratio Studiorum, formulated by the Jesuit order, and a strict standard of scholarship is maintained. The facilities of the university include the Coleman Museum of Natural History, the Beauchamp Hughes Art Cabinet and the Riggs Memorial Library. In 1916 there were reported a faculty of 196 and a student enrolment of 1,526. Books in library, 153,000.

GEORGIA, in Europe (by the Russians called Grusia, by the natives Karthli), formerly a kingdom, but now included in the Russian government of Tiflis and Kutais, though the name is sometimes loosely employed to designate a much larger portion of the territory possessed by Russia south of the Caucasus. Area, in the latter sense, about 34,000 square miles; of Georgia proper, about 15,000 square miles. The history of the Georgians first become trustworthy about the time of Alexander the Great, to whom they became subject. After Alexander's death, in 323 B.C., they gained their independence under Pharnvas. The country was then governed by various dynasties of kings. Christianity was introduced toward the close of the 4th century; soon after the death of Mohammed, numerous followers of his entered the country and compelled the inhabitants to accept Islam. In the 11th century Georgia was twice invaded by the Seljuk Turks, but regained its independence under David III (1090–1125), and in the 13th, after widespread devastation, was captured by the Mongols under Timur. The Mongols were expelled in 1403 by George VII who committed the error of dividing it among his three sons, further subdivisions making it into 26 different principalities. In the 16th and 18th centuries Georgia was harried by the Persians, and at the same time the Turks were continually making encroachments. Aga Mohammed Shah in 1795 razed Tiflis to the ground, the king, Heraclius II, abandoning all resistance and taking refuge in the mountain fastnesses. Russian influence, begun by lending aid against invasion, had been growing steadily; and in 1799 George XIII formally resigned the crown in favor of the Emperor Paul of Russia, and in 1801 Russia annexed the country. Consult Brosset, 'Eléments de la Langue Georgienne' (1837): Chubinov, 'Russian-Georgian Dictionary' (1846; new ed., 1886); Leist, 'Georgische Dichter Verdeutscht' (1887); Wardrop, 'The Kingdom of Georgia' (1888). See GEORGIANS.

GEORGIA, the last settled of the 13 original States of the American Union; bounded on the north by North Carolina and Tennessee, on the northeast by South Carolina, on the east by South Carolina and the Atlantic Ocean, on the south by Florida and on the west by Alabama; capital, Atlanta; area, 59,475 square miles, of which 495 are water.

Topography.— The northeastern part of Georgia is traversed by that part of the Appalachian chain of mountains known as the Blue Ridge, which in Georgia has an altitude of from 3,000 to 5,000 feet above sea-level. After running one third the distance across the State, it terminates abruptly, but appears again in short ranges and detached peaks. Northwest Georgia, the limestone region, embracing about 3,600 square miles, has an altitude ranging from between 600 and 700 to 2,500 feet above sea-level. About 6,000 square miles of northern Georgia are above the altitude of 1,000 feet. About 20 miles to the west of the Blue Ridge lies the Cohutta Range, a continuation of the range known in Tennessee as the Unaka. The Cohutta has an altitude of 3,000 feet above sea-level with an abrupt escarpment toward the valley of the Oostenaula on the west and then continues into Alabama in a low elevation called Dugover Mountain. To the northwest are Lookout and Sand Mountain ranges, which with their table-lands constitute a part of the Alleghany range, which, like the Blue Ridge, belongs to the great Appalachian system.

High Point, the loftiest part of Lookout Mountain, has an elevation of 2,408 feet. Its northeastern spur, called Pigeon Mountain, has an elevation of from 1,800 to 2,000 feet above the sea, its highest point rising to 2,331 feet. Another spur of Lookout, called Round Mountain, has an elevation of over 2,200 feet. Taylor's Ridge and its prolongation, called the White Oak Mountains, rise to an elevation of from 1,300 to 1,500 feet above sea-level. A little farther south, Rocky Face Ridge, with an elevation of from 1,500 to 1,700 feet, forms the eastern watershed of Chickamauga Creek (or river, as it is sometimes called), which flows through the valley at an elevation of 900 feet above the sea. There are several detached peaks, among which the most noted are Pine, Lost and Kennesaw Mountains, the last named with its double peak rising to the height of 1,809 feet. In De Kalb County, 14 miles east of the city of Atlanta, in a comparatively level country, Stone Mountain, a vast mass of granite, rises to the height of 1,686 feet.

One of the most prominent features of northeast Georgia is the Blue Ridge chain of mountains, already mentioned. Some of the peaks of this chain rise to an elevation of 5,000 feet. The following is a list of the most noted of the mountain peaks of Georgia with their height above the level of the sea: Sitting Bull (middle summit of Nantahela), in Towns County, 5,046 feet; Mona (east summit of Nantahela), 5,039 feet; Enota, in Towns County, 4,797 feet; Rabun Bald, in Rabun County, 4,718 feet; Blood, in Union County, 4,468 feet; Tray, in Habersham County, 4,403 feet; Cohutta, in Fannin County, 4,155 feet; Dome, in Towns County, 4,042 feet; Grassy, in Pickens County, 3,290 feet; Tallulah, in Habersham County, 3,172 feet; Yona, in White County, 3,167 feet. In all the mountain section of Georgia are charming valleys abounding in very productive lands. The most noted are Cedar, Texas, Broomtown and Vann's valleys in northwest Georgia, and Nacoochee (Evening Star) and Sautee valleys in the northeast section of the State. Among the interesting features of northwest Georgia are numerous caves. Hardin's Cave, near Kingston, has chambers 20 to 30 feet high. Middle Georgia is the most thickly settled section of the State. With the exception of two mountains, this region varies in altitude from 180 to 500 feet, and in a few instances to 1,000 feet. Lands too steep for the plow are seldom found in middle Georgia.

South Georgia embraces more than half the area of the State and extends from the southern limit of middle Georgia to Florida and the Atlantic coast. Its altitude ranges from 100 to 500 feet. About 3,000 square miles of the coastal region have an elevation of 100 feet.

Rivers.— The drainage system of Georgia comprises nine basins. The Tennessee basin is drained by tributaries of the Tennessee River. The Mobile basin is drained into the Gulf of Mexico by the Coosa and Tallapoosa rivers and their tributaries. The Apalachicola basin is drained by the Chattahoochee and Flint rivers. These, uniting in the southwestern corner of Georgia, form the Apalachicola River which, flowing through Florida, empties into a bay of the same name, an arm of the Gulf of Mexico. The Altamaha basin is drained by the Oconee and Ocmulgee rivers, which empty into the Altamaha, flowing into the Atlantic Ocean. The Ogeechee basin is drained by the Ogeechee River into the Atlantic Ocean through Ossabaw Sound. The Savannah basin is drained by the Savannah River and its tributaries into the Atlantic Ocean. The Ocklockonee basin is drained by the river of that name into the Gulf of Mexico through Ocklockonee Bay. The Suwanee basin is drained by the river of that name into the Gulf of Mexico. Although the Suwanee runs for the greater part of its course through the State of Florida, it rises in southeast Georgia, and two of its main tributaries, the Allapaha and Withlacoochee rivers, are streams of south-central Georgia. The Satilla and Saint Mary's basin is drained by the Satilla and Saint Mary's rivers. The Satilla is the more northern and enters the Atlantic through Saint Andrew's Sound. The Saint Mary's enters the Atlantic Ocean through Cumberland Sound. Between these rivers lies the noted Okefinokee swamp. Its numerous large rivers furnish the State with excellent water transportation. Although the extensive railroad lines have built up in Georgia flourishing cities and towns remote from any water highway, yet those which are upon navigable streams enjoy the advantage of a competing water line. The Savannah is the most important river of Georgia for the reason that over 18 miles of its course is navigable for ocean vessels. The Savannah is navigable for river steamboats to Augusta, 230 miles to the north. The Chattahoochee is navigable for steamboats from Columbus to the Apalachicola and through that stream to the Gulf of Mexico. Through its several steamboat lines Columbus has a considerable river trade. The city of Rome in northwest Georgia has besides its several railroad lines a fine river trade through the Oostanaula and the Coosa. Steamboats carry to Rome the productions of the Coosa Valley, lumber, iron, grain and cotton, and the staple products of the Oostanaula valley. Albany, in southwest Georgia, enjoys an extensive steamboat traffic by the Flint River. The Saint Mary's River is navigable for the largest vessels up to and beyond the town of that name, which is nine miles from the ocean. The Satilla and Ogeechee are each navigable for some distance, but their advantages have not been utilized to any considerable extent. Other navigable waters of Georgia are the inlets and sounds flowing between the mainland and the islands that skirt the coast from the Savannah to the Saint Mary's rivers. Through Saint Simon's Sound the largest vessels pass up the Turtle River, a short but deep stream, to the city of Brunswick, the second in importance of the ports of Georgia, being, like Savannah, the centre of a fine fruit and trucking section. Every section of Georgia is drained by rivers of considerable size and is consequently a splendid agricultural country. Its numerous navigable streams, supplementing its great railroad systems, conspire to give its people unusual advantages for both internal and foreign commerce.

Climate.— Of nine climate belts in the United States eight are represented in Georgia. The lowest of these eight belts in mean annual temperature is below 40°, the highest between 70° and 75°. The climate of less than 40° mean annual temperature is found only on some of the mountain peaks. On the sides of these mountains below the summit the mean annual temperature is between 40° and 45°, corresponding with upper New England and New York and the mountain region of Virginia. There is a still larger climate zone of between 45° and 50° which corresponds with that to be found in portions of New York, Pennsylvania, and Ohio. The zone of between 50° and 55° embraces a narrow strip which runs northward through North Carolina and Virginia up to New Jersey. The zone between 55° and 60° of mean annual temperature contains an area two or three times as large as all the preceding zones together and, passing through both Carolinas, ends in Virginia. The zone between 60° and 65° embraces nearly all of middle Georgia, corresponding with that of upper Alabama, Mississippi, Louisiana, Texas, west Tennessee and Arkansas, and extends into Virginia. The mean annual temperatures at some of the important stations in this area are: Rome, 61.9; Gainesville, 61.3; Atlanta, 61.4; Carrollton, 62; Athens, 63; Augusta, 64; LaGrange, 64.1; Thomson, 64.7.

The climate of southern Georgia is between 65° and 70° of mean annual temperature and corresponds with that of southern Texas, Louisiana, Mississippi and upper Florida. At Macon it is 66.1°; Cuthbert, 68.1°; Americus, 68.2°; Brunswick, 68.7°. Blackshear with 70.2° is the only station touching the zone between 70° and 75°. For the whole State the mean temperature for July is 81.8°. The isothermal line of 80°, July temperature, runs above Augusta and Macon to West Point. Above this line embracing the greater portions of north and middle Georgia the July temperature is between 75° and 80°. Below this line, embracing the greater part of east Georgia and nearly all of southeast and southwest Georgia, the July temperature is between 80° and 85°. The climate of Atlanta, situated as it is on a ridge 1,050 feet above sea-level, corresponds with that of Washington, Saint Louis and Louisville, the winters being warmer and the summers cooler. Snow seldom falls in southern Georgia, and then rarely to a depth of more than two inches. In middle Georgia the fall of snow is a little more frequent and to a greater depth, while both its frequency and depth are greatly increased in the mountain region. The annual average rainfall of Georgia is 49.3 inches, the highest being at Rabun Gap, 71.7 inches, the lowest at Swainsboro, 39.4 inches. Atlanta's annual rainfall is 52.12 inches. The average for different sections of the State is: Middle Georgia, 49.7 inches; east Georgia, 41.4 inches and northwest Georgia, 60.3 inches. The summer rainfall averages: For north Georgia, 13.6 inches; for southwest Georgia, 14.5 inches, and for the entire State, 13.4 inches. The summer rainfall averages at different localities: Rome, 10.2 inches; Atlanta, 10.8 inches; Rabun Gap, 15.4 inches; Americus, 16 inches; Brunswick, 16.6 inches.

Agriculture.— The northwestern section of Georgia presents a great variety of surface and soil. The slopes of the mountains and hills are well suited for the grazing of stock, and abundance of land, either rolling or entirely level in the valleys, is adapted to the raising of vegetables, fruits, corn, wheat, rye, oats, barley, buckwheat, cowpeas, clover, timothy, orchard grass, Bermuda, Johnson, crab, red top and many other grasses useful for hay and pasturage. Cotton also is a profitable crop as far north as Floyd County, above which very little of this crop is raised. Some of the chief fruits are peaches, apples, pears, cherries, all kinds of berries and grapes of every variety. The forest timbers are oaks of several varieties, pines of two varieties, also the poplar, ash, beech, elm, chestnut, hickory, maple, walnut, iron wood, sugar berry, sycamore, sweet-gum, dogwood, persimmon, sassafras, wild cherry,

GEORGIA

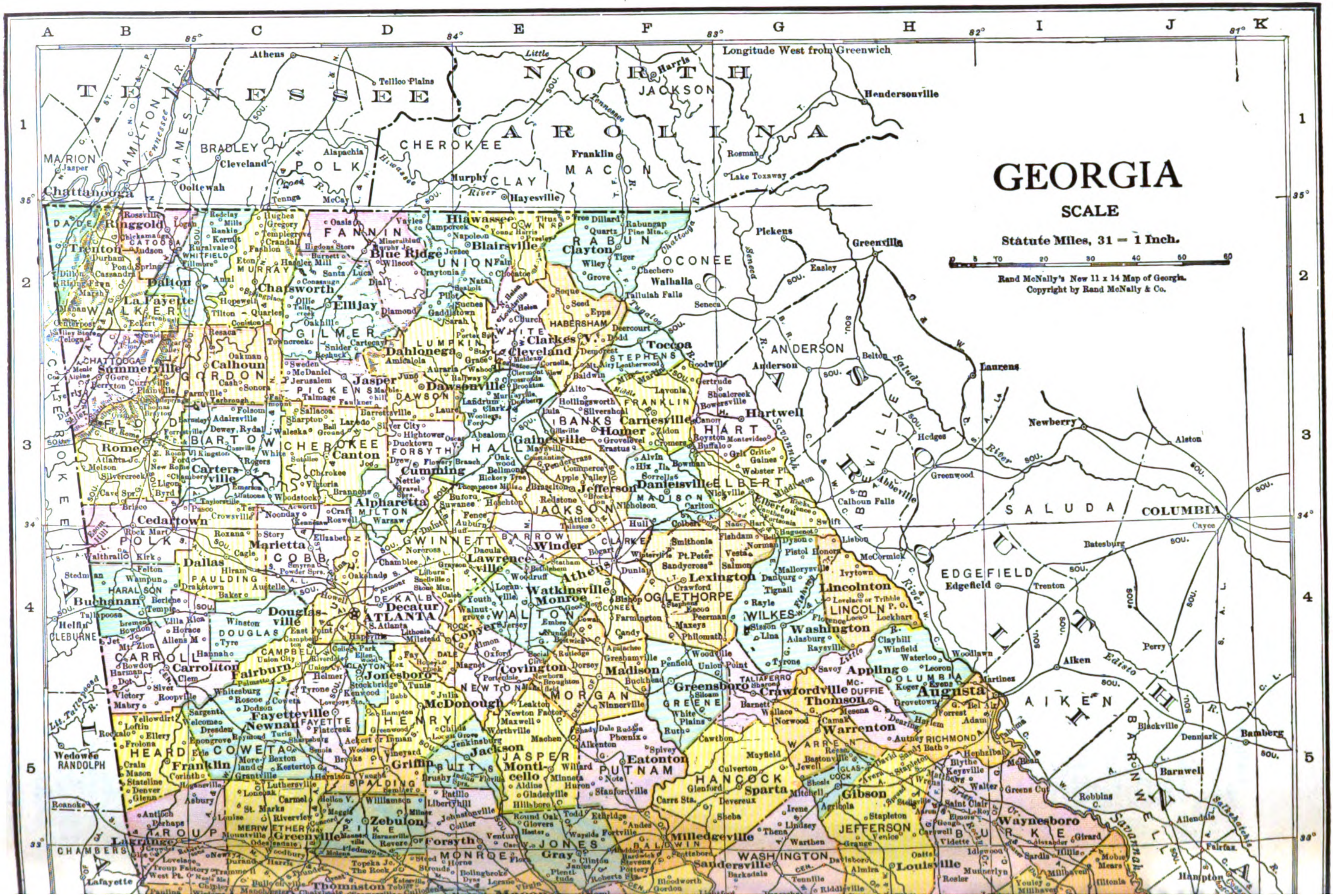
Estimated population, 2,856,065

COUNTIES

Pop.		
12,318	Appling	H 8
.....	Bacon (Pop. incl. in Appling and Pierce Cos.)	G 8
7,973	Baker	D 9
18,354	Baldwin	F 5
11,244	Banks	F 3
.....	Barrow (Pop. incl. in Walton, Gwinnett & Jackson Cos.)	E 3
25,388	Bartow	C 3
11,863	Ben Hill	F 8
22,772	Berrien	F 9
56,646	Bibb	E 6
.....	Bleckley (Pop. incl. Pulaski Co.)	F 7
23,832	Brooks	E 10
6,702	Bryan	J 8
26,464	Bulloch	I 7
27,268	Burke	I 5
13,624	Butts	E 5
11,334	Calhoun	C 9
7,690	Camden	I 10
10,874	Campbell	C 4
.....	Candler (Pop. incl. in Bulloch and Emanuel Cos.)	H 7
30,855	Carroll	B 4
7,184	Catoosa	B 2
4,722	Charlton	H 10
79,690	Chatham	J 7
5,586	Chattahoochee	C 7
13,608	Chattooga	B 2
16,661	Cherokee	D 3
23,273	Clarke	F 4
8,960	Clay	B 8
10,453	Clayton	D 4
8,424	Clinch	G 10
28,397	Cobb	C 4
21,953	Coffee	G 9
19,789	Colquitt	E 9
12,328	Columbia	H 5
28,800	Coweta	C 5
8,310	Crawford	E 6
16,423	Crisp	E 8
4,139	Dade	A 2
4,686	Dawson	D 3
29,045	Decatur	C 10
27,881	Dekalb	D 4
20,127	Dodge	F 7
20,554	Dooly	E 7
16,035	Dougherty	D 9
8,953	Douglas	C 4
18,122	Early	C 9
3,309	Echols	G 10
9,971	Effingham	J 7
24,125	Elbert	G 3
25,140	Emanuel	H 6
.....	Evans (Pop. incl. in Tattnall Co.)	H 7
12,574	Fannin	D 2
10,966	Fayette	D 5
36,736	Floyd	B 3
11,940	Forsyth	D 3
17,894	Franklin	F 3
177,733	Fulton	D 4
9,237	Gilmer	D 2
4,669	Glascock	G 5
15,720	Glynn	J 9
15,861	Gordon	C 3
18,457	Grady	D 10
18,512	Greene	F 5
28,824	Gwinnett	D 4
10,134	Habersham	E 2
25,730	Hall	E 3
19,189	Hancock	G 5
13,514	Haralson	B 4
17,886	Harris	C 6
16,216	Hart	G 3
11,189	Heard	B 5
19,927	Henry	D 5
23,609	Houston	E 7
10,461	Irwin	F 8
30,169	Jackson	E 3
16,552	Jasper	E 5
6,050	Jeff Davis	G 8
21,379	Jefferson	H 5
11,520	Jenkins	I 6
12,897	Johnson	G 6
13,103	Jones	E 5
35,501	Laurens	G 7
11,679	Lee	D 8
12,924	Liberty	I 8
8,714	Lincoln	H 4
24,436	Lowndes	F 10
5,444	Lumpkin	D 2
10,325	McDuffie	H 5
6,442	McIntosh	J 9
15,016	Macon	D 7
16,851	Madison	F 3
9,147	Marion	C 7
25,180	Meriwether	C 5
7,986	Miller	C 9
7,239	Milton	D 3
22,114	Mitchell	D 9
20,450	Monroe	E 6
19,638	Montgomery	G 7
19,717	Morgan	F 5
9,763	Murray	C 2
36,227	Muscogee	C 6
18,449	Newton	E 4
11,104	Oconee	F 4
18,680	Oglethorpe	F 4
14,124	Paulding	C 4
9,041	Pickens	D 3
10,749	Pierce	H 9
19,495	Pike	D 5
20,203	Polk	B 4
22,835	Pulaski	F 7
13,876	Putnam	F 5
4,594	Quitman	B 8
5,562	Rabun	F 2
18,841	Randolph	C 8
58,886	Richmond	H 5
8,916	Rockdale	E 4
5,213	Schley	D 7
20,202	Screven	I 6
19,741	Spalding	D 5
9,728	Stephens	F 2
13,437	Stewart	C 7
29,092	Sumter	D 7
11,696	Talbot	C 6
8,766	Taliaferro	G 4
18,569	Tattnall	I 7
10,839	Taylor	D 6
13,288	Telfair	G 8
22,003	Terrell	D 8
29,071	Thomas	E 10
11,487	Tift	F 9
11,206	Toombs	H 7
3,932	Towns	E 2
26,228	Troup	B 5
10,075	Turner	E 8
10,736	Twiggs	F 6
6,918	Union	E 2
12,757	Upson	D 6
18,692	Walker	B 2
25,393	Walton	E 4
22,957	Ware	H 9
11,860	Warren	G 5
28,174	Washington	G 6
13,069	Wayne	I 8
6,151	Webster	C 7
......	Wheeler (Pop. incl. in Montgomery Co.)	G 7
5,110	White	E 2
15,934	Whitfield	C 2
13,486	Wilcox	F 8
23,441	Wilkes	G 6
10,078	Wilkinson	F 6
19,147	Worth	E 4

Incorporated Cities, Towns, and Villages

Pop.		
1,201	Abbeville	F 8
200	Acree, Dougherty	D 9
1,043	Acworth, Cobb	C 4
751	Adairsville	C 3
1,902	Adel	F 9
816	Adrian	G 6
99	Aikenton	E 5
306	Alley	G 7
249	Alamo	G 7
10,604	Albany	D 8
532	Allapaha	F 9
458	Alma	H 8
356	Alpharetta	D 3
109	Alto	E 3
8,305	Americus	D 7
174	Andersonville, Sumter	D 7
481	Apalachee	F 4
433	Arabi	E 8
280	Argyle	G 9
1,308	Arlington	C 9
162	Armena	D 8
2,214	Ashburn	E 8
17,846	Athens	F 4
190,558	Atlanta	D 4
59	Atwater, Upson	D 6
217	Auburn	E 3
50,245	Augusta	H 5
755	Austell	C 4
60	Avalon, Stephens	F 2
228	Avera	H 5
402	Babcock	C 9
391	Baconton	D 9
4,217	Bainbridge	C 10
280	Baldwin	E 3
448	Ball Ground	D 4
3,068	Barnesville	D 5
303	Barney	F 10
384	Bartow	H 6
381	Barwick	E 10
831	Baxley	H 8
358	Beach	H 8
193	Bellton, Hall	E 3
209	Bethlehem	E 4
104	Between, Walton	E 4
14	Beverly, Elbert	G 3
463	Bibb City, Muscogee	C 6
268	Bishop, Oconee	F 4
1,235	Blackshear	H 9
203	Blairsville	E 2
1,838	Blakely	B 9
898	Blue Ridge	D 2
325	Bluffton	C 8
257	Bogart, Oconee	F 4
111	Bold Spring, Walton	E 4
144	Bolingbroke	E 6
1,130	Boston	E 10
333	Bostwick	E 4
541	Bowdon, Carroll	B 4
398	Bowersville	G 3
738	Bowman	G 3
64	Boykin, Miller	C 9
95	Braswell, Paulding	C 4
890	Bremen	B 4
214	Brewton	G 7
707	Brinson	C 10
198	Bristol	H 9
465	Bronwood	D 8
361	Brooklet	I 7
1,040	Broxton	G 8
10,872	Brunswick	J 9
462	Buchanan	B 4
384	Buckhead	F 5
1,061	Buena Vista	C 7
1,683	Buford	E 3
204	Bullochville	C 6
173	Bushnell	G 8
705	Butler	D 6
300	Byromville	E 7
154	Cadwell	G 7
1,505	Cairo	D 10
1,652	Calhoun	C 3
241	Camak	G 5
1,827	Camilla	D 9
145	Campton, Walton	E 4
728	Canon	F 3
2,002	Canton	D 3
166	Carl, Barrow	E 3
325	Carlton	F 3
322	Carnesville	F 3
3,297	Carrollton	C 4
4,067	Cartersville	C 3
805	Cave Spring	B 3
354	Cecil	F 9
3,551	Cedartown	B 3
208	Center, Jackson	E 3
119	Centralhatchee, Heard	B 5
147	Chalybeate Springs, Meriwether	C 5
129	Chamblee	D 4
314	Chatsworth	C 2
350	Chauncey	F 7
278	Chester, Dodge	F 7
312	Chickamauga	B 2
742	Chipley, Harris	C 6
528	Clarkesville	E 2
349	Clarkston, Dekalb	D 4
1,008	Claxton	I 7
541	Clayton	F 2
328	Climax	C 10
254	Cobbtown	H 7
1,638	Cochran	F 7
255	Colbert	F 3
354	Coleman	C 8
2,173	College Park, Fulton	D4
327	Collins	H 7
600	Colquitt	C 9
25,950	Columbus	B 7
868	Comer, Madison	F 3
2,238	Commerce	F 3
450	Concord	D 5
303	Coolidge	E 10
1,919	Conyers	E 4
5,883	Cordele	E 8
147	Corinth	B 5
1,114	Cornelia	E 2
290	Cotton, Mitchell	D 9
2,697	Covington	E 4
150	Covington Mills, Newton	E 4
220	Crandall	C 2
871	Crawford	F 4
688	Crawfordville	G 5
159	Crest, Upson	D 6
198	Crosland	E 9
365	Culloden	D 6
305	Cumming	D 3
341	Cusseta	C 7
3,210	Cuthbert	C 8
169	Dacula	E 4
829	Dahlonega	D 2
1,259	Dallas	C 4
5,324	Dalton	B 2
272	Danburg	G 4
323	Danielsville	F 3
299	Danville	F 6
1,391	Darien	J 9
589	Davisboro	G 6
3,827	Dawson	D 8
179	Dawsonville	E 3
2,466	Decatur	D 4
760	Demorest	F 2
149	Deepstep, Washington	G 6
288	De Soto	D 8
550	Dexter	F 7
173	Dickey, Calhoun	C 8
400	Diffee, Decatur	C 10
106	Dillard	F 2
242	Dixie, Brooks	E 10
630	Doerun	E 9
747	Donalsonville	C 9
163	Dooling	E 7
147	Doraville, Dekalb	D 4
3,550	Douglas	G 8
1,462	Douglasville	C 4
5,795	Dublin	G 7
302	Dudley	F 7
469	Duluth	D 4
342	Du Pont	G 10
291	East Ellijay, Gilmer	D2
73	East Lake, Dekalb	D 4
2,355	Eastman	F 7
3,682	East Point	D 4
385	East Thomaston, Upson	D 6
127	Eastville, Oconee	F 4
2,036	Eatonton	F 5
841	Edison	C 8
6,483	Elberton	G 3
123	Elizabeth	C 4
273	Elko	E 7
672	Ellaville	D 7
659	Ellijay	D 2
316	Emerson	C 3
338	Enigma, Berrien	F 9
218	Epworth, Fannin	D 2
80	Etna, Polk	B 4
307	Eton	C 2
1,395	Fairburn	C 4
326	Fairmount	C 3
709	Fayetteville	C 5
211	Ficklin, Wilkes	G 4
232	Finleyson	F 7
5,795	Fitzgerald	F 8
142	Flint Stone, Walker	B 2
495	Flovilla	E 5
373	Flowery Branch	D 3
355	Folkston	H 10
173	Forest Park, Clayton	D 4
2,208	Forsyth	D 5
1,320	Fort Gaines	B 8
2,697	Fort Valley	E 6
340	Franklin	B 5
95	Frazier, Pulaski	F 7
326	Fry, Fannin	D 2
236	Funston, Colquitt	E 9
5,925	Gainesville	E 3
319	Garfield	H 6
210	Gay	C 5
210	Geneva	C 6
313	Georgetown	B 8
367	Gibson	G 5
216	Gillsville	E 3
227	Girard	I 5
640	Glennville	H 9
347	Glennwood	G 7
337	Godfrey, Morgan	F 5
151	Good Hope	E 4
702	Gordon	F 6
193	Graham	G 8
1,132	Grantville	C 5
95	Gratis, Walton	E 4
417	Graymont	H 7
278	Grayson	D 4
152	Graysville, Catoosa	B 2
2,120	Greensboro	F 5
909	Greenville	C 5
7,478	Griffin	D 5
61	Grovania	E 7
558	Grovetown	H 5
545	Guyton	J 7
312	Haddock	E 6
784	Hagan	I 7
650	Hahira	F 10
403	Hamilton	C 6
1,093	Hampton	D 5
864	Hapeville	D 4
736	Harlem	H 5
174	Haralson	C 5
383	Harrison	G 6
1,882	Harrisonville, Richmond	H 5
2,007	Hartwell	G 3
3,420	Hawkinsville	F 7
1,181	Hazlehurst	H 8
890	Helena	F 8
656	Hephzibah	I 5
214	Herod, Ferrell	D 8
226	Hiawassee	E 2
231	Hickox	I 9
207	Higgston, Montgomery	G 7
550	High Shoals, Oconee	F 4
209	Hillsboro	E 5
93	Hilton	B 9
174	Hinesville	I 8
254	Hiram	C 4
1,230	Hogansville	C 5
251	Holly Spring, Cherokee	D 3


GEORGIA
SCALE
Statute Miles, 31 = 1 Inch.
Rand McNally's New 11 x 14 Map of Georgia.
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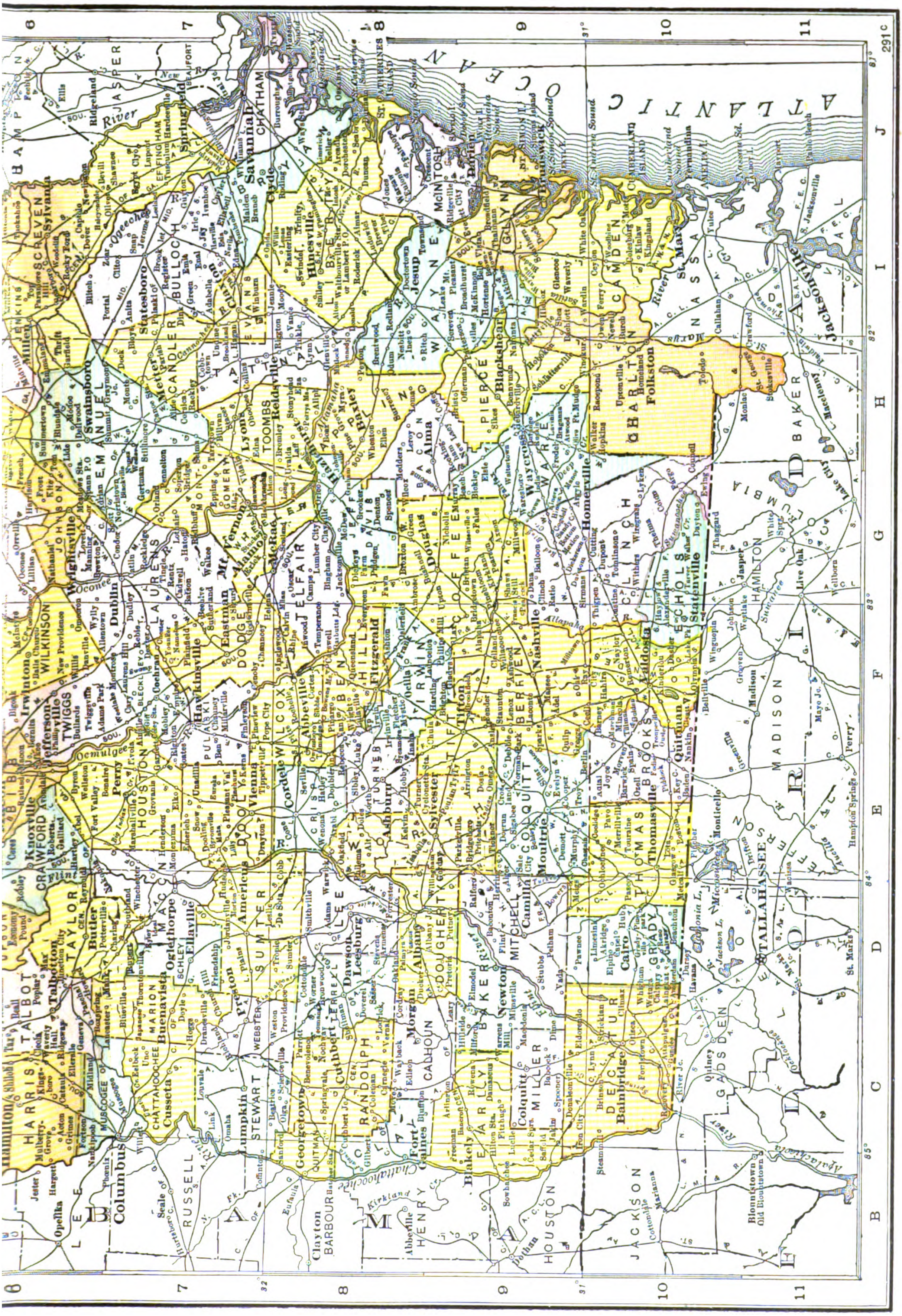
Longitude West from Greenwich
TENNESSEE
NORTH CAROLINA
SOUTH CAROLINA
ALABAMA
Atlanta
Augusta
Athens
Macon
Chattanooga
Rome
Marietta
Milledgeville
Columbia
Greenville
Anderson
Abbeville
Edgefield
Aiken


ATLANTIC
OCEAN
Savannah
Jacksonville
TALLAHASSEE
Columbus
Brunswick
Valdosta
Thomasville
Albany
Waycross
291c

Pop.		
114	Homeland	H 10
228	Homer	F 3
437	Homerville	G 9
429	Hoschton	E 3
194	Howell, Echols	G 10
133	Hull	F 3
186	Ideal, Macon	D 7
459	Iron City	C 10
249	Irwinton	F 6
111	Isabella	E 8
1,862	Jackson	E 5
662	Jakin	C 9
332	Jasper	D 3
1,207	Jefferson	F 3
740	Jeffersonville	F 6
237	Jenkinsburg	E 5
191	Jersey	E 4
1,415	Jesup	I 8
970	Jonesboro	D 4
225	Junction City	C 6
573	Kennesaw	C 4
413	Kestler	C 9
190	Kingsland	I 10
522	Kingston	C 3
267	Kingwood, Colquitt	E 9
1,226	Kirkwood, Dekalb	D 4
241	Kite, Johnson	G 6
211	Knoxville	E 6
1,590	Lafayette	B 2
5,587	La Grange	B 5
285	Lake Park	F 10
1,712	Lavonia	F 3
1,518	Lawrenceville	E 4
430	Leary	C 9
77	Leatherwood, Douglas	C 4
705	Leesburg	D 8
531	Lela	C 10
206	Lenox	F 9
100	Leon, Dodge	F 7
393	Leslie	D 7
545	Lexington	F 4
221	Lilly	E 7
375	Lincolnton	H 4
533	Linwood, Walker	B 2
227	Lithia Springs, Douglas	C 4
1,428	Lithonia	D 4
716	Locust Grove	D 5
600	Loganville	E 4
247	Lone Oak	C 5
1,039	Louisville	H 6
54	Louvale	G 7
198	Lovejoy Station	D 5
165	Lovett	G 6
541	Ludowici	I 8
309	Lula	E 3
1,195	Lumber City	G 8
1,140	Lumpkin	C 7
349	Luthersville	C 5
322	Lyerly	B 3
927	Lyons	H 7
1,253	McCaysville, Fannin	D 2
882	McDonough	D 5
1,160	McRae	G 8
160	Machen	E 5
74	Machinery City, Cobb	C 4
45,757	Macon	E 6
2,412	Madison	F 4
922	Manchester	C 6
589	Mansfield	E 5
290	Mapleton, Mitchell	D 9
5,949	Marietta	C 4
1,082	Marshallville	E 7
337	Martin	F 3
334	Maxeys	F 4
805	Maysville, Banks	F 3
233	Meansville	D 5
697	Meigs	D 9
376	Menlo, Chattooga	B 2
109	Merrillville	E 10
314	Metcalf	D 10
408	Metter	H 7
603	Midville	H 6
287	Milan	G 8
4,385	Milledgeville	F 5
2,030	Millen	H 6
1,247	Milltown	F 9
400	Milner	D 5
338	Mineral Bluff	D 2
221	Mitchell	G 5
398	Molena	D 6
184	Moniac	H 10
3,029	Monroe	E 4
1,630	Montezuma	E 7
1,508	Monticello	E 5
312	Moreland	C 5
302	Morgan	C 8
195	Morganton, Fannin	D 2
383	Morven	F 10
3,349	Moultrie	E 9
256	Mount Airy	E 2
158	Mountain City, Rabun	F 2
605	Mt. Vernon	G 7
226	Mountville	C 5
140	Mystic	F 8
990	Nashville	F 9
538	Naylor	F 10
503	Nellieville, Richmond	H 5
550	Nelson, Pickens	D 3
475	Newborn	E 4
139	NewEngland, Dade	A 2
5,548	Newnan	C 5
364	Newton	D 9
720	Nicholls, Coffee	G 9
167	Nicholson	F 3
968	Norcross	D 4
648	Norman Park	E 9
87	Norristown	G 6
340	Norwood	G 5
174	Nunez	H 7
144	Oak Park, Emanuel	H 6
276	Oakfield, Worth	E 8
233	Oakhurst, Dekalb	D 4
110	Oakwood	E 3
350	Ochlochnee	E 10
2,017	Ocilla	F 8
10	Oconee	G 6
161	Odessadale	C 5
258	Odum	H 8
483	Offerman	H 8
924	Oglethorpe	D 7
101	Ohoopee	H 7
243	Oliver	J 6
209	Omaha	C 7
274	Omega	E 9
457	Orland	G 7
655	Oxford	E 4
922	Palmetto, Campbell	C 4
360	Parrott	C 8
32	Patten, Thomas	E 10
264	Patterson	H 9
572	Pavo	E 10
558	Pearson	G 9
1,880	Pelham	D 9
467	Pembroke	I 7
239	Pendergrass	E 3
475	Penfield	F 5
454	Pepperton, Butts	E 5
649	Perry	E 7
451	Pinehurst	E 7
708	Pineview	F 7
279	Pitts	F 8
400	Plains	D 7
148	Plainville	B 3
337	Pooler, Chatham	J 7
652	Poulan	E 9
315	Powder Springs	C 4
259	Preston	C 7
369	Prestoria	D 9
57	Primrose, Meriwether	C 5
63	Princeton, Clarke	F 4
207	Pulaski	I 7
3,915	Quitman	F 10
113	Raccoon Mills	B 3
300	Rays Mills	F 9
252	Rebecca	E 8
454	Reidsville	I 7
275	Rentz	F 7
112	Resaca	C 2
521	Reynolds	D 6
321	Rhine	F 8
1,250	Richland	C 7
398	Ringgold	B 2
225	Rising Fawn	B 2
139	Riverdale	D 4
170	Riverside, Colquitt	E 9
227	Roberta, Crawford	E 6
860	Rochelle	F 8
152	Rockledge	G 7
1,034	Rockmart	B 4
385	Rocky Ford	I 6
61	Rocky Mount, Meriwether	C 5
15,120	Rome	B 3
173	Roopville	B 5
1,059	Rossville, Walker	B 2
1,158	Roswell	D 3
1,422	Royston	F 3
88	Ruckersville, Elbert	G 3
120	Russell, Jackson	E 3
696	Rutledge	E 4
91	St. Charles, Coweta	C 5
272	St. George	H 11
54	St. Marks	C 5
691	St. Marys	I 10
402	Sale City	E 9
2,641	Sandersville	G 6
441	Sasser	D 8
68,805	Savannah	J 7
212	Scott	G 6
276	Screven	I 8
120	Seney, Polk	B 4
1,111	Senoia	D 5
193	Seville	E 8
344	Shady Dale	E 5
246	Sharon	G 4
166	Sharpsburg	C 5
985	Shellman	C 8
266	Smithsonia	F 4
574	Smithville	D 8
599	Smyrna	C 4
1,590	Social Circle	E 4
469	Soperton	G 7
842	Sparks	F 9
1,715	Sparta	G 5
370	Spread	G 5
504	Springfield	J 7
242	Spring Place	C 2
162	Springvale	C 8
2,529	Statesboro	I 7
621	Statham	E 4
149	Stellaville	H 5
171	Sterling, Glynn	J 9
645	Stillmore	H 7
1,062	Stone Mountain	D 4
197	Sugar Valley	B 2
125	Summertown	G 6
657	Summerville	B 2
4,361	Summerville, Richmond	H 5
566	Summit	H 6
336	Sumner, Worth	E 8
259	Surrency	H 8
250	Suwanee	E 3
1,313	Swainsboro	H 6
107	Swords, Morgan	F 4
296	Sycamore	E 8
1,400	Sylvania	I 6
1,447	Sylvester	E 8
1,081	Talbotton	D 6
108	Talking Rock, Pickens	D 3
2,117	Tallapoosa	B 2
85	Tallulah Falls	F 4
236	Tarrytown	G 7
197	Taylorsville	C 3
711	Temple	B 4
145	Tennga	C 1
1,622	Tennille	G 6
138	The Rock	D 6
1,645	Thomaston	D 6
6,727	Thomasville	E 10
2,151	Thomson	G 5
2,381	Tifton	F 9
125	Tiger	F 2
320	Tignall	G 4
242	Tilton	C 2
3,120	Toccoa	F 2
404	Toomsboro	F 6
302	Trenton	B 2
1,721	Trion	B 2
295	Tunnelhill, Whitfield	C 2
263	Turin	C 5
786	Tybee, Chatham	J 7
276	Ty Ty	E 9
1,003	Unadilla	E 7
534	Union City	C 4
1,363	Union Point	F 4
7,656	Valdosta	F 10
189	Van Wert, Polk	B 4
1,776	Vidalia	H 7
75	Vidette	H 5
1,564	Vienna	E 7
855	Villa Rica	B 4
326	Waco, Haralson	B 4
872	Wadley	H 6
243	Waleska	D 3
112	Walnut Grove	E 4
149	Waresboro	G 9
1,368	Warrenton	G 5
151	Warthen	G 5
226	Warwick	D 8
3,065	Washington	G 4
543	Wassaw, Chatham	J 8
483	Watkinsville	E 4
19,869	Waycross	H 9
2,729	Waynesboro	I 5
250	West Buford, Gwinnett	D 4
319	Weston	C 8
1,906	West Point	B 6
627	Whigham	D 10
230	Whitehall, Clarke	F 4
407	White Plains	F 5
315	Whitesburg, Carroll	B 4
50	White Sulphur Springs, Meriwether	C 5
960	Willacoochee	F 9
179	Williamson	D 5
443	Winder	E 3
2.204	Winokur	H 9
168	Winston	C 4
465	Winterville	F 4
155	Woodbine	I 10
917	Woodbury	C 6
189	Woodland	C 6
442	Woodstock	D 3
162	Woolsey	D 5
169	Worth	E 8
616	Wren	H 5
.389	Wrightsville	G 6
1 366	Yatesville	D 6
283	Young Harris	E 2
602	Zebulon	D 5

rosebud, warhoo, cedar and buckeye. In northeast Georgia but little over 12 per cent of the land is under cultivation, because this part of the State is thinly inhabited; but many of the tillable lands have a very rich, dark red soil. Little Tennessee Valley in Rabun County and Nacoochee Valley in White County are noted for fertility, bearing all kinds of crops, fruits and grasses. About 75 per cent of the whole area known as middle Georgia is under cultivation. The central cotton region of the State includes the southern part of middle and large areas of southern Georgia. This region embraces the sand and pine hills belt, the red hills belt and the yellow loam region. The first of these covers about 3,000 square miles, the other two about 12,000 square miles. Large crops of corn and cotton are raised throughout this area except in the sand hills belt. In the long-leaf pine region there are 17,000 square miles and here the vast forests of long leaf pine have been a great source of wealth to the State, but less now than formerly. Wherever the timber lands are cleared, they are being put under cultivation. The marls and swamp muck found in this section, when mixed, form a cheap and excellent fertilizer. The pine and palmetto flats around Okefinokee swamp furnish large quantities of long leaf pine, cypress and saw palmetto, while along the creek-bottom and hummock lands are found these same trees, black-gum, tupelo-gum, titi and maple. The coast region, about 2,045 square miles, includes the savannas, live-oak lands and islands. The coast lands from the Savannah to the Saint Mary's River are noted for magnificent live oaks, also red and water oaks, red cedar, hickory, chinquapin, sassafras, cabbage and the blue palmetto. Along the coast lands rice is cultivated, and the Georgia sea islands produce the larger part of the finest cotton known to commerce. All over middle and southern Georgia grows the sugarcane, richer in saccharine matter than any other known plant from which sugar is extracted.

By reason of its more than 4½° of latitude and different altitudes of its various sections, Georgia produces the crops and fruits of every section of the Union, and on its sea islands and extreme southern section of its mainland many of those of the tropics, such as oranges, lemons, bananas, etc. Pomegranates and figs are found all over the State.

The census of 1900 gave the total value of Georgia's agricultural products at $86,345,343. The census of 1910 gave the value of Georgia's agricultural products as $226,595,436, an increase of 162.4 per cent. The value of all farm property according to the census of 1900 was $228,374,637, and by the census of 1910 was $580,546,381, an increase of 154.2 per cent. The Georgia cotton production for the five years from 1911 to 1915 gives a five-year average of 2,323,000 bales per annum. The largest yearly production during that period was 2,794,000 bales in 1911 and the smallest was 1,812,000 bales in 1912. The crop of 1915 was 1,937,000 bales. The five-year average of Georgia's cotton crop was $142,429,000. The largest yearly value of the cotton crop in Georgia was $174,540,000 in 1913, and the lowest $119,400,000 in 1912. The value of the crop in 1915 was $139,570,000. In any ordinary year the peach crop of Georgia is worth at least $4,000,000, and in some years it will far exceed those figures. Georgia outranks all the States in the number and quality of her watermelons.

Stock raising is very profitable to those who engage in it. In southern Georgia cattle and sheep need very little shelter and for only a few weeks of the winter. The number of specified domestic animals in 1918 was: Dairy cows, 435,000; other neat cattle, 755,000; horses, 130,000; mules and asses, 334,000; sheep (lambs not included), 144,000; swine, 2,766,000. Of poultry there were 4,549,144 chickens, 103,416 turkeys, 208,997 geese and 64,895 ducks. The total value of domestic animals, poultry and bees in 1900 was $35,200,507 and 1910 it was $80,393,993, an increase of 128.4 per cent. The average value of land per acre was $5.25 in 1900 and $13.74 in 1910, an increase of 161.7 per cent.

Geology and Mining.—There are three main geological divisions of Georgia. The Palæozoic in the northwest embraces the counties of Dade, Walker, Catoosa, Whitfield, Chattooga, Floyd, and the greater parts of Murray, Gordon, Bartow and Polk. Cambrian, Silurian, Devonian and Carboniferous formations are represented. The rocks are chiefly shales, sandstones, limestone, quartzites and cherts. This is a region of parallel valleys and mountain ridges in which are found valuable deposits of coal, iron, aluminum (or bauxite), manganese and roofing slate. Hydraulic cement rock is found in large quantities in Bartow County. The crystalline area includes that portion of the State not in the Palæozoic area that runs north of a line extending through Columbus, Macon, Milledgeville and Augusta. In this area are granites, schists and gneisses, and in the region which borders both the Palæozoic and crystalline areas are found the marbles for which Georgia is so famous. The marble belt traverses Fannin, Gilmer, Pickens and Cherokee counties, the most important quarries being in Pickens County. Large quantities of granite and gneiss are found in many localities in the crystalline area.

The gold deposits are found in four belts. The first runs through Rabun, Habersham, White, Lumpkin, Dawson, Forsyth, Cherokee, Cobb, Bartow, Paulding, and Haralson counties. The second belt traverses Rabun, Habersham, Hall, Gwinnett, Forsyth, Milton, De Kalb and Fulton counties. A third belt traverses Cobb, Paulding and Carroll counties. A fourth belt goes through Lincoln, Columbia, McDuffie, and Warren counties in the southeast part of the crystalline area. There are some irregular deposits in Towns, Union, Gilmer, Fannin and Meriwether counties. The iron ores are in the Palæozoic area. The brown iron ores are mined in Bartow, Polk and Floyd counties. The red iron ores are mined in Walker and Chattooga counties. Ochre occurs in Bartow County, manganese in Bartow and Floyd. The largets bauxite deposits are in Floyd and Bartow counties, but it occurs also in Polk, Walker and Chattooga counties. Corundum deposits are found in Rabun, Towns, Union, Habersham, Carroll and Heard counties. Laurel Creek mine in Rabun County near the Carolina line is the largest in Georgia, and one of the most noted in the United States. Pyrite is found in Lumpkin County; copper in Murray and Fannin counties; graphite near Emerson; asbestos in several localities in the crystalline area; talc in Murray, Fannin and Cherokee; mica in Union and Fannin; barite in Bartow. Of precious stones amethysts are found in Rabun County, a few diamonds in Hall County, some good moonstones in Upson County. Rubies and sapphires of small size have been found in the northeast part of the crystalline area. The coal fields of Georgia are in Dade and Walker counties.

Limestone beds of good quality for both calcimining and building purposes are found in the Palæozoic area and in Hall and Habersham counties in the crystalline area. Limestone for calcimining is also found in different localities in the coastal plain region, which takes in all the southern portion of Georgia. In this region are found marls and phosphates. Through all that part of the State north of the fall line, which runs from Columbus through Macon to Augusta, are found clays suitable for the manufacture of common brick and the coarser grades of earthenware, while immediately below the fall line in a narrow belt across the State are clays suitable for the manufacture of porcelain, enameled brick, chinaware, terra-cotta, sewer pipes, etc. The annual output of all the mineral products of Georgia is nearly $5,000,000.

Manufactures.— Georgia stands in the front rank of the Southern States in the variety and value of its manufactures and the number of its manufacturing establishments.

The latest report of textile mills in Georgia is that issued by the Georgia Department of Commerce and Labor under date of 31 Dec. 1917. It is as follows: 171 mills; capital, $60,513,980.76; spent for raw material, $102,992,982.03; value of manufactured products, $147,405,132.33. These products were from coarse to the finest cotton fabrics. There were 2,448,260 active spindles and 46,038 active looms. The wage earners numbered 42,011 and their wages amounted to $18,577,577.44.

The textile mills include cotton, woolen, knitting mills and one silk mill. Besides these there are manufactories of pants, overalls, shirts, garments for women and children, awnings, tents and mattresses. Among other manufacturing interests the most important are printing establishments, flour and grist mills, furniture factories, brass, steel and iron works, foundries, blast furnaces, carriage factories, car shops, blacksmithing and wheelwrighting, brick, tile and pottery manufactories, marble and stone works, manufactories of paints, chemicals and ice; electric light plants, carpenter work, canning factories, creameries and numerous others.

The cotton oil mills in operation in 1901 numbered 58. They paid above $5,000,000 for cotton seed, which they manufactured into various products, valued at $14,000,000. The fertilizer factories registered with the Commissioner of Agriculture for the season of 1902–03 numbered 82, many of them being of great capacity and having an immense trade all over the Southern States. The cotton oil mills in 1917 numbered 180, and manufactured products to the value of $52,000,000. The fertilizer factories and mixing plants in 1917 numbered 303, and sold products valued at $41,640,000.

The United States Department of Commerce in April 1916 gave for Georgia the following comparative summary of total manufactures for 1914 and 1909. Capital in 1914 was $258,849,000 as compared with $202,778,000 in 1909; cost of materials in 1914 was $160,199,000 as against $116,970,000 in 1909; value of products $253,320,000 in 1914 as against $202,863,000 in 1909; value of products, less cost of materials, in 1914 was $93,121,000 against $85,893,000 in 1909.

Railroads.— The total steam railroad mileage of Georgia in 1917 is 7,385, and the electric lines will increase this to above 8,000 miles.

Highways.— Georgia has 80,000 miles of public roads, of which 40,000 can be traveled by automobile. The highway commissioners, in co-operation with the counties and aided by the Federal government, hope to have 5,500 miles of perfect highway within the next five years.

Telegraph and Telephone Lines.—Georgia ably supplements the United States postal routes and free deliveries with 207,000 miles of telephone wires and more than 100,000 miles of telegraph wires.

Electric Lights.— More than 160 towns and rural retreats are lighted by electricity, also many country homes near cities and large towns.

Banks and Finances.— Georgia has 638 state banks with 25 branch banks, which have a capital of $28,388,701.89, a surplus of $18,026,660.75, and deposits of $108,269,388.76. Georgia's national banks number 111, and have a capital of $14,653,000, a surplus of $9,509,000 and deposits of $95,572,000. The Federal Reserve Bank of the 6th regional district is located in Atlanta. In 1910 the assessed valuation of Georgia's property, including public utilities, was $766,787,139; the bonded debt was $6,844,000, and the tax rate was $5 per $1,000. The assessed valuation in 1915 was $951,763,472; the bonded debt was $6,844,000, and the tax rate $4.80 per $1,000.

Religion.— The number of communicants in the various Christian bodies in Georgia is approximately as follows: Baptists, 672,000; Methodists, 420,000; Presbyterians, 30,000; Episcopalians, 12,000; Disciples, 10,000; Roman Catholics, 25,000. The Hebrews in Georgia number about 7,000.

Education.— In the public school system there are 8,363 schools, of which 4,985 are for whites and 3,378 are for negroes. The total number of teachers is 14,382, of which 10,013 are white and 4,369 colored. The number of normal trained teachers is 5,548, of which 4,424 are white and 1,124 colored. The total number of children of school age is 795,484, of which the whites number 429,011 and the colored 366,473. The total enrolment is 625,854, the whites being 385,167 and the colored 240,687. The above figures are for 1915, during which year the attendance was 422,838, of which 273,388 were white and 149,450 colored. The per cent of attendance was 70.9 for white and 62 for colored. The amount of money given by the State for the support of the public schools in 1915 was $2,700,000, and the amount raised by local taxation was $2,387,729, a total of $5,087,729. The total number enrolled in

State colleges was 5,073; in denominational and private colleges, 4,588. In negro institutions, 1,544. The private schools below college grade would add to the above enrolment some 5,000 more.

Schools of Higher Learning.— In addition to Georgia's excellent public school system, she has many colleges, also schools where special industrial work is done. A list of the schools of higher learning is as follows: Georgia Normal and Industrial College, for girls, and Georgia Military College (Milledgeville); Auburn College, Christian (Auburn); Mercer University, Baptist, including the Mercer Law Schools and the Mercer School of Pharmacy; Wesleyan College, Methodist Episcopal Church, South, the oldest chartered institution for females in the world; Saint Stanislaus, Catholic; Mount de Sales, Catholic; Georgia School for the Blind, White Department (Macon); First District Agricultural School (Statesboro); Fourth District Agricultural School (Carrolton); Chatham Academy, an endowment school from the early colonial days (Savannah); Rhinehart College, Methodist Episcopal Church, South, co-ed. (Waleska); University of Georgia, with Academic, Law School of Pharmacy; State Normal School, co-ed; Georgia State College of Agriculture; Lucy Cobb Institute (Athens); Seventh District Agricultural School (Powder Springs); Eleventh District Agricultural School (Douglas); Agnes Scott College, Presbyterian; Donald Frazier Institute (Decatur, DeKalb County); Emory University, Methodist Episcopal Church, South (Decatur, Atlanta); Shorter College, Baptist (Rome); Georgia Institute for the Deaf, White Department (Cave Springs); Atlanta Medical College (Emory University, Methodist Episcopal Church, South); Emory Theological Department; Marist College for Boys, Catholic; Georgia College of Eclectic Medicine and Surgery; Atlanta Dental College; Southern Dental College; Atlanta College of Pharmacy; Atlanta Law School; Atlanta Theological Seminary, Congregational; Georgia School of Technology (Atlanta, Fulton County); Emory University, Methodist Episcopal Church, South; Oglethorpe University, Presbyterian (Atlanta, DeKalb County); Cox College for girls, Baptist; Georgia Military Academy (College Park); Ninth District Agricultural School (Clarkesville); Piedmont College (Demorest); Brenau College, Female; Riverside Military Academy (Gainesville); Tenth District Agricultural College (Granite Hill, near Sparta); Warthen College (Wrightsville); South Georgia Normal College (Valdosta); North Georgia Agricultural College (Dahlonega); Bessie Tift College, Baptist (Forsythe); Brewton-Parker Institute, Baptist (Mt. Vernon-Ailey); Eighth District Agricultural College (Madison); North Highland Industrial School (Columbus); Emory College, Methodist Episcopal Church, South (Oxford); Gordon Institute, for boys and girls; Sixth District Agricultural School (Barnesville); Andrew Female College, Methodist Episcopal Church, South (Cuthbert); Academy of Richmond County, one of the Colonial endowed schools; Georgia Medical College, a branch of the State University (Augusta); Third District Agricultural School (Americus); South Georgia College, Methodist Episcopal Church, South (McRae-Helena); Second District Agricultural School (Tifton); Young Harris College, Methodist Episcopal Church, South, for boys and girls (Young Harris); Hiawassee College, Baptist, for boys and girls (Hiawassee); LaGrange Female College, Methodist Episcopal Church, South; Southern Female College, Baptist (LaGrange); Fifth District Agricultural School (Monroe).

Institutions for Negroes.— Atlanta University, Clarke University, Morehouse College, Morris Brown College, Spelman Seminary (Atlanta); Payne College, Methodist Episcopal Church, South (Augusta); Georgia School for the Deaf, Colored Department (Cave Springs); George School for the Blind, Colored Department (Macon); Georgia State Industrial College (Savannah).

Benevolent Institutions.— There are in Georgia a number of noted benevolent institutions. Some of the more important are given below: Hebrew Orphan Home; Old Ladies' Home; Florence Crittenden Home; Confederate Soldiers Home (Atlanta); Augusta Orphan Home (Augusta); Orphan Home of the North Georgia Conference (Decatur); Baptist Orphan Home (Hapeville); Orphan Home of South Georgia Conference; Appleton Home for Girls; Episcopal Home for Old Ladies; Georgia Industrial Home; Masonic Home (Macon); Georgia State Sanitarium (Milledgeville); Bethesda Orphan Home, founded in 1739 by George Whitfield; Abram's Home for Widows; Saint Francis Orphan Home, Catholic; Savannah Female Orphan Asylum; Episcopal Orphan Home; Saint Mary's Orphan Home (Savannah).

The following are benevolent institutions for colored: Carrie Steele Orphan Home, Leonard Street Orphan Home (Atlanta); Colored Orphan Home and Industrial School, Chatham Colored Orphan Home (Savannah, Chatham County); Negro Orphan Home (Augusta); Negro Orphan Home (Macon).

Local Tax Counties.— The following counties supplement the State public school fund with a local school tax: Bacon, Ben Hill, Bibb, Bryan, Burke, Butts, Camden, Chatham, Clarke, Clinch, Coffee, Columbia, Crisp, DeKalb Echols, Emanuel, Fulton, Glascock, Glynn, Hancock, Hart, Henry, Houston, Irwin, Jasper, Jeff Davis, Jenkins, Jones, Lee, McIntosh, Mitchell, Monroe, Montgomery, Morgan, Muscogee, Newton, Pulaski, Quitman, Rabun, Randolph, Richmond, Screven, Spalding, Stewart, Talbot, Terrell, Tift, Walton, Wayne, Wheeler, Worth.

State Government.— The State constitution adopted in 1877 carefully guards the rights of the people and prevents extravagant appropriations by the legislature. The governor is elected for two years and receives a salary of $5,000. The state-house officers are: the attorney-general, comptroller-general, adjutant-general, treasurer, secretary of state, state school commissioner, commissioner of agriculture, commissioner of commerce and labor, State geologist, State librarian, commissioner of pensions, three prison commissioners and three railroad commissioners. The prison commissioners have charge of prisons and of highways. The Supreme Court consists of one chief justice and five associate justices. The Court of Appeals consists of six judges. There are 28 superior court circuits, each having a judge and a solicitor. Georgia is represented in the national Congress by two senators and 12 representatives.

Population and Division.— The population of Georgia at each census is as follows: (1790) 82,548; (1800) 162,686; (1810) 252,433; (1820) 340,985; (1830) 576,823; (1840) 691,392; (1850) 906,185; (1860) 1,057,286; (1870) 1,184,109; (1880) 1,542,180; (1890) 1,837,353; (1900) 2,216,331; (1910) 2,609,121. The total white population in 1900 was 1,181,109, and the total colored 1,034,998. There are 152 counties in the State. The total white population in 1910 was 1,431,802, and the total negro population was 1,176,987. There were also 95 Indians, 233 Chinese and 4 Japanese. The total native population was 2,593,644 and the total foreign 15,477. The total United States estimate for 1916 is 2,800,000.

Of 372 incorporated places in Georgia 40 had a population in 1910 of more than 2,000 and 23 of these had a population in excess of 5,000. Atlanta, the capital, had 154,839; Savannah, the chief seaport, had 65,064; Augusta, one of the greatest cotton manufacturing cities of the South, had 41,040; Macon had 40,665; Columbus, another great cotton manufacturing city, had 20,554. Other cities of the State having over 7,000 inhabitants in 1910 are: Albany, 8,190; Athens, 14,913; Brunswick, 10,182; Americus, 8,063; Rome, 12,099; Griffin, 7,476; Waycross, 14,485; Valdosta, 7,656. Atlanta has, by United States census estimates, 190,000 in 1916, and Savannah, 75,000.

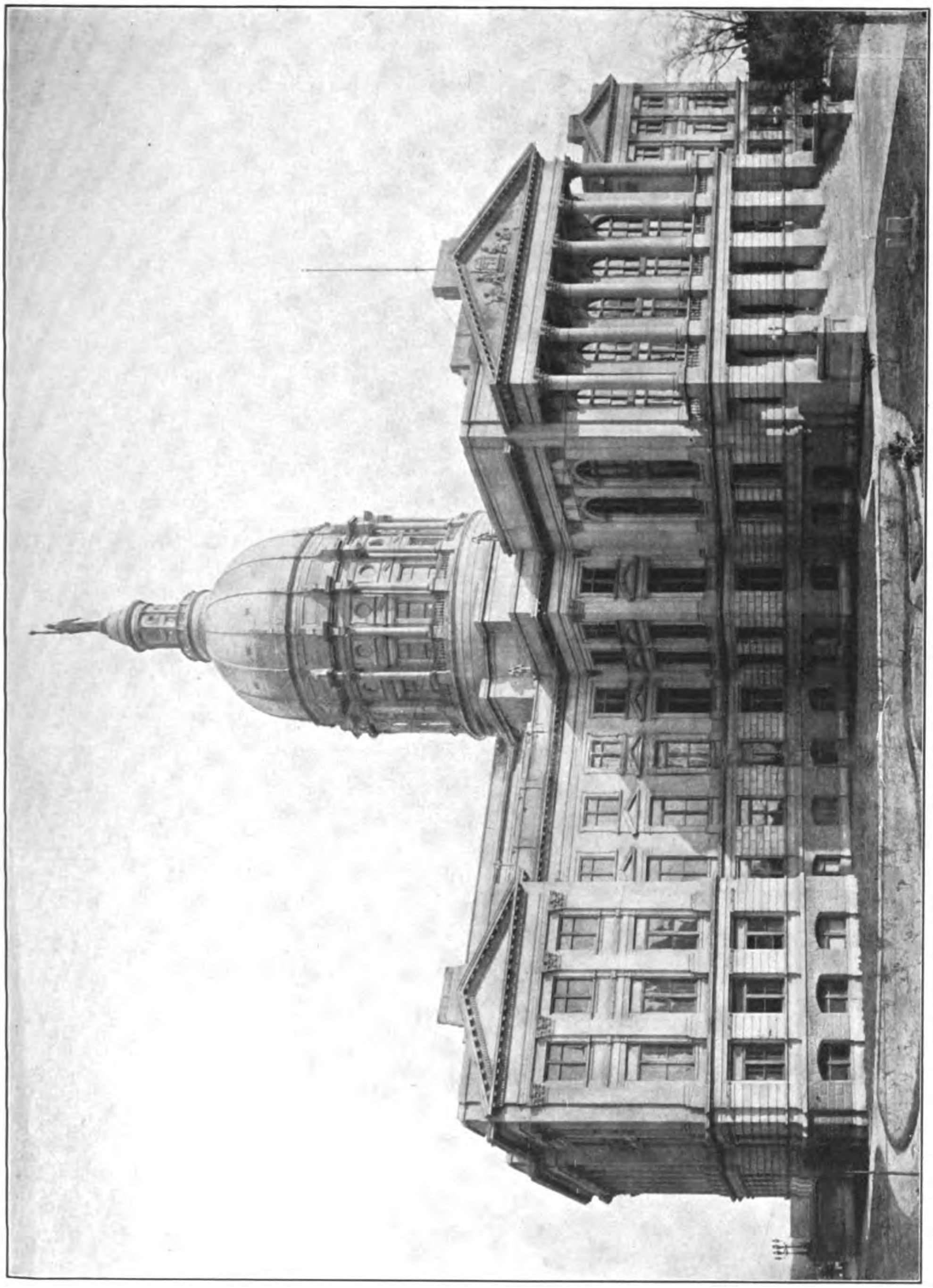
History.— A charter for the establishment of the colony of Georgia was obtained from George II, king of England, in June 1732, by a number of benevolent gentlemen of London, whose design was to found a home for the poor of Great Britain and a place of refuge for the Salzburgen and other persecuted sects of the continent of Europe. The colony was also intended as a military settlement to serve as a barrier against encroachments of the Spaniards upon South Carolina. Gen. James Edward Oglethorpe, a man of great liberality and of marked ability and experience in military affairs, being selected by the trustees as governor, brought over 116 emigrants. Landing at Yamacraw Bluff on 12 Feb. 1733, they laid the foundations of the city of Savannah and colony of Georgia. At first rum and slavery were prohibited, but in 1747 these restrictions were removed. During the 10 years of Oglethorpe's administration many settlers of a very desirable kind were brought into the colony, peace with the Indians was secured by treaties, their lands being in every instance procured by purchase, a formidable Spanish invasion was defeated, John and Charles Wesley and George Whitfield preached to the people and Whitfield founded the Orphan Home at Bethesda, a few miles from Savannah. In 1752 the trustees of Georgia surrendered their rights to the Crown and in 1754 John Reynolds was appointed governor. At the close of the French and Indian War the boundaries of Georgia, which had embraced a territory between the Savannah and the Altamaha rivers, were extended to the Mississippi on the west, and to latitude 31° and the Saint Mary's River on the South. Subsequently they were extended on the south to lat. 30° 21′ 39″. Georgia united with other colonies in resisting the aggressions of the mother country. On 11 May 1775 Col. Joseph Habersham and Commodore Bowen and 30 volunteers seized the powder magazine at Savannah and secured 13,000 pounds of powder, of which the Georgia authorities sent 5,000 pounds to the Continental army at Boston. In March 1776 the Georgians under Colonel McIntosh aided by the Carolinians under Colonel Bull burned three and disabled six out of 11 merchant vessels which under the protection of some British war vessels were endeavoring to carry on trade with some loyalist planters. In April 1776 Georgia instructed her delegates in Congress to vote for Independence. The signers of the Declaration on the part of Georgia were Button Gwinnett, Lyman Hall and George Walton. In December 1778 the British captured Savannah and early in 1779 Augusta. But the Carolinians under Andrew Pickens and the Georgians under John Dooly and Elijah Clarke by the victory of Kettle Creek recovered Augusta. Subsequently the British defeated Ashe at Brier Creek and repulsed the combined attack of the Americans under Lincoln and the French under D'Estaing at Savannah. This battle at Savannah was one of the most important conflicts of the Revolution. After the fall of Charleston, S. C., in 1780, the British overran all eastern Georgia. But Col. Elijah Clarke made a desperate effort to retake Augusta. Failing, he tried again in 1781 and by the assistance of Pickens and "Light Horse" Harry Lee succeeded. Almost the last fight of the Revolution was Wayne's victory over the Indian Allies of the British, near Savannah, 23 June 1782. On 11 July 1782 Savannah was evacuated by the British and the authority of Georgia was established over all her borders. On 2 Jan. 1788 a convention of delegates from the different counties of the State at Augusta ratified the Constitution of the United States on the behalf of Georgia.

In 1802 Georgia ceded to the Federal government all her lands west of the Chattahoochee embracing the greater part of the present States of Alabama and Mississippi. In 1807 Milledgeville became the capital. During the second war with Great Britain 1812–15 the Georgians under Gen. John Floyd gained several battles over the Indians and shared with the Tennesseeans in the decisive victories won over the savages by Gen. Andrew Jackson. In the Mexican War, Georgia's sons were distinguished, among whom Col. James S. McIntosh was killed at Molino del Rey and W. H. T. Walker was desperately wounded at Chapultepec.

Georgia seceded from the Union 19 Jan. 1861 and furnished to the Confederate army 94 regiments and 36 battalions, embracing every arm of the service. On Georgia soil were fought the battles of Chickamauga, Ringgold, Resaca, New Hope Church, Kennesaw Mountain, Peach Tree Creek, Atlanta, Jonesboro, Allatoona and numerous smaller engagements and skirmishes. At the close of the Civil War, Georgia resumed her enterprises in every industrial line, not waiting even for her re-entrance into the Union, which occurred in 1870. During the Spanish-American War Georgia furnished more volunteers in proportion to population than any other State.

Among prominent Georgia citizens have been Gen. Joseph Wheeler, William H. Crawford, John McPherson Berrion, George M.

GEORGIA



State Capitol at Atlanta

Troup, George R. Gilmer, Herschel V. Johnson, Howell Cobb, Robert Toombs, Alexander H. Stephens, Joseph E. Brown, John B. Gordon, Alfred H. Colquitt, Benjamin H. Hill, Sidney Lanier, Frank Starton, Charles Hubner, James R. Randall, Dr. F. O. Ticknor. Some of the above list of prominent Georgians were born in other States, but they belong to the list of Georgia citizens. Dr. J. Crawford Long, the discoverer of anæsthesia; Bishop George F. Pierce, and a long list of able governors too numerous to name here. Between 1868 and 1870, in Augusta, pupils of the author of this sketch, included Woodrow Wilson, now President of the United States; Joseph R. Lamar, late justice of the United States Supreme Court, and Pleasant Stovall, former United States Minister to Switzerland.

The following is a complete list of the governors of Georgia:

UNDER THE TRUSTEES.

James Edward Oglethorpe	1732–1743
William Stephens	1743–1751
Henry Parker	1751–1754

UNDER THE CROWN.

John Reynolds	1754–1757
Henry Ellis	1757–1760
James Wright	1760–1782

Governor Wright fled the colony, when in 1776 the patriots seized the reins, but soon after the capture of Savannah on 29 Dec. 1778, returned as royal governor for all that part of Georgia in the hands of the British. He remained in that capacity until 11 July 1782, when Savannah was formally surrendered to the Americans who had recovered all upper Georgia on 5 June 1781, when Pickens, Lee and Clarke captured Augusta and its British garrison.

UNDER THE AMERICAN RULE IN THE COLONIAL PERIOD.

Wm. Ewen, President of the Council of Safety and recognized by the patriots as Governor	1775–1776
Archibald Bulloch, President of the Provincial Council and Commander-in-Chief	20 Jan. 1776–22 Feb. 1777
Button Gwinnett with same title	22 Feb. 1777–8 May 1777

UNDER THE STATE CONSTITUTION ADOPTED IN 1777

John A. Treutlen	8 May 1777–8 Jan. 1778
John Houston	8 Jan. 1778–29 Dec. 1778
John Wereat, President of Executive Council, Acting Governor	29 Dec. 1778–4 Nov. 1779
George Walton	4 Nov. 1779–7 Jan. 1780
Richard Howley	7 Jan. 1780–7 Jan. 1781
Stephen Heard, President of Executive Council and Acting Governor	7 Jan. 1781–15 Aug. 1781
Nathan Brownson	15 Aug. 1781–8 Jan. 1782
John Martin	8 Jan. 1782–9 Jan. 1783
Lyman Hall	1783
John Houston	1784
Samuel Elbert	1785
Edward Telfair	1786
George Mathews	1787
George Handley	1788
George Walton, Democratic-Republican	1789–90
Edward Telfair, Democratic-Republican	1790–93
George Mathews, Democratic-Republican	1793–96
Jared Irwin, Democratic-Republican	1796–98
James Jackson, Democratic-Republican	1798–1801

Beginning under the State constitution of 1777 and continuing under the State constitution of 1798, in which there was a clause forbidding the African slave trade in Georgia.

UNDER THE STATE CONSTITUTION OF 1798.

David Emanuel	Democratic-Republican.	1801
Josiah Tattnall	"	1801–02
John Milledge	"	1802–06
Jared Irwin	Democratic-Republican.	1806–09
David B. Mitchell	"	1809–13
Peter Early	"	1813–15
David B. Mitchell	"	1815–17
William Rabun	"	1817–19
Mathew Talbot	"	1819
John Clark	"	1819–23
George M. Troup	"	1823–27
John Forsyth	"	1827–29
George R. Gilmer	National Republican (later Whig)	1829–31
Wilson Lumpkin	Democrat	1831–35
William Schley	"	1835–37
George R. Gilmer	Whig	1837–39
Charles J. Macdonald	Democrat	1839–43
George W. Crawford	"	1843–47
George W. B. Towns	"	1847–51
Howell Cobb	"	1851–53
Herschel V. Johnson	"	1853–57
Joseph E. Brown	"	1857–65
James Johnson	"	1865
Charles J. Jenkins	"	1865–67
Gen. T. H. Ruger	Military	1867–68

UNDER THE STATE CONSTITUTION OF 1868.

Rufus B. Bullock	Republican	1868–71
Benjamin Conley	"	1871–72
James M. Smith	Democrat	1872–77
Alfred H. Colquitt	"	1877–82

First term under State constitution of 1868, the second under State constitution of 1877.

OTHER GOVERNORS UNDER THE STATE CONSTITUTION OF 1877.

Alexander H. Stephens	Democrat	1882–83
Henry D. McDaniel	"	1883–86
John B. Gordon	"	1886–90
William J. Northen	"	1890–94
William Y. Atkinson	"	1894–99
Allen D. Candler	"	1899–1903
Joseph M. Terrell	"	1903–07
Hoke Smith	"	1907–09
Joseph M. Brown	"	1909–11
Hoke Smith	" (1 July–15 Nov.)	1911
Joseph M. Brown	"	1911–13
John M. Slaton	"	1913–15
N. E. Harris	"	1915–17
Hugh M. Dorsey	"	1917–

Bibliography.— Bulletins of the Geological Survey of Georgia (1914 et seq.); Brooks, 'History of Georgia' (Philadelphia 1913); Derry, 'Story of Georgia' (Chicago 1913); Evans, 'History of Georgia' (New York 1903); Jones, 'History of Georgia to 1783' (Boston 1883); McCallie, 'Mineral Resources of Georgia' (Atlanta 1911); McElreath, 'The Constitution of Georgia' (Atlanta 1911); McPherson, 'Government of the People of the State of Georgia' (New York 1913); Stephens, 'War between the States' (Philadelphia 1879); Stevens, Wright and Derry, 'Georgia, Historical and Industrial' (Atlanta 1901); White, 'Statistics of the State of Georgia' (Savannah 1849), and 'Historical Collections of Georgia' (New York 1855).

JOSEPH T. DERRY.

GEORGIA, South, an island in the south Atlantic, 850 miles east-southeast of the Falkland Islands, of which it is a political dependency. It is 120 miles long from northwest to southeast and 30 broad; its coasts are rock-bound and more or less precipitous, but the sea locks afford excellent anchorage. Inland a range of mountains culminates in Mount Paget (8,383 feet). Whaling is the only industry. Pop. over 1,000.

GEORGIA, Strait of, a large inlet of the North Pacific Ocean, between the continent of North America and Vancouver's Island; about 250 miles in length from north to south; the breadth varies greatly in its different parts, from 6 miles to 25. It communicates with the ocean on the north by Queen Charlotte's Sound, and on the south by the Strait of Juan de Fuca.

GEORGIA, University of, an important university which is at the head of State education in Georgia. It was chartered in 1785 and is the oldest State university. The charter coordinates primary and secondary schools with the university in the scheme of education by the State. The institution was located at Athens, and began academic work in 1801. This is the parent institution and includes four colleges: (1) Franklin College, the college of the liberal acts. (2) State College of Agriculture and the Mechanic Arts, on the Morrill foundation. (3) Law School. (4) Graduate School. The phrase "University of Georgia" in the wider sense includes the various colleges in different parts of the State which are declared by law to be "parts" of the university. These are: North Georgia Agricultural and Mechanical College, at Dahlonega; Medical College, at Augusta; School of Technology, at Atlanta; Georgia Normal and Industrial College, for women, at Milledgeville; State Normal School, for men and women, at Athens; Industrial College, for negroes, at Savannah. The university, in the collective sense, including students of college grade and those in professional schools and in its preparatory schools, had an attendance of about 5,000 in 1917. The members of the faculties number 165. These institutions are managed for the most part by local boards or commissions, but legal title and control of all of them is vested in the single board of trustees of the university. This is a unique feature of organization of the higher education of the State and differentiates it from the system of any other State. Understood in the narrower sense, the single institution at Athens has regularly from 350 to 400 students, and its income is $50,000 per annum. Among the alumni of national reputation are Howell Cobb, speaker of the House of Representatives for one session and (under Buchanan in 1857) Secretary of the Treasury; Alexander H. Stephens; John A. Campbell, justice of the United States Supreme Court; Senators Robert Toombs, Benjamin H. Hill, Augustus O. Bacon; Joseph and John LeConte, afterward president and professor in the University of California Henry Timrod, poet; Henry W. Grady and J. L. M. Curry, diplomat and educator. As the university is a State institution, tuition is free for residents of Georgia in all schools except the professional schools; non-residents pay a small fee.

GEORGIA BARK, a small tree, *Pinckneya pubens,* of the Southern States, closely resembling the cinchona or Peruvian bark, and belonging to the family *Rubiaceæ.* It has pretty large white flowers, with longitudinal stripes of rose-color, disposed in beautiful clusters at the extremities of the branches; each flower is accompanied by a floral leaf, bordered with rose-color near the upper margin; the corolla is tubular; the stamens five, with a single style; and the capsule contains two cells and numerous seeds. The wood is soft and is therefore unfit to be used in the arts. The inner bark is extremely bitter, and is employed with success in intermittent fevers.

GEORGIA SCHOOL OF TECHNOLOGY, a scientific institute at Atlanta, Ga., founded in 1888, and forming part of the University of Georgia. It has a hospital, medical school, Y. M. C. A. building and a large athletic field. It has also modern electrical, mechanical and civil engineering laboratories. The value of the plant is about $800,000. The library contains 15,000 volumes. It has 60 instructors and 1,000 students in all departments.

GEORGIAN ARCHITECTURE, a neo-classic style of architecture that flourished in England from about 1715 to 1820, during the reigns of the four Georges, from whom it derives its name. It is a modified form of the Italian or Palladian style, divested of excessive ornamentation and was well adapted for domestic architecture and interior decoration, and is to be found throughout the United States in buildings of the Colonial period, where it is known as the Colonial or old Colonial style. Among its prominent exponents were Gibbs, Campbell, the brothers Adam, Chambers and Dance; Somerset House and the church of Saint Martin's-in-the-Fields, London, are fine types of the style. It was abandoned during the architectural stagnation in the second quarter of the 19th century, and was followed by the Gothic and Greek revivals. Consult Wallis, F. E., 'The Georgian Period' (3 vols., Boston 1898–1902).

GEORGIAN BAY, Canada, formerly Lake Manitoulin, the northeastern part of Lake Huron, partly separated from the main body of the lake by the peninsula of Cabot's Head and the island of Great Manitoulin, province of Ontario. It is about 120 miles long and 50 broad.

GEORGIAN SERIES. See Geology: Cambrian System.

GEORGIANS, or IBERNIANS, or GRUSINIANS. The people (about 600,000) who speak the Georgian language call themselves Karthveli, but are also named Grusini, and inhabit the valley of the upper and middle Kur, those of the Rion and Tchoruk, as far as the promontories of the Ararat chain and north to the Alazan, beyond which their language is mixed with the tongues of Shirvan and Daghestan as far as the Caspian Sea. Probably descendants of the Colchi and Albani, they were anciently called Iberi, and, according to tradition, are akin to the Armenians, although their language differs from the Haikanian (*Somasi* in Georgian), and is believed by their learned prince Theimuraz to be primitive. Brosset and Voss (1847) place it among the Indo-European languages. It consists of several dialects, namely: The Karthveli or Georgian proper in the centre, the Kakheti and Imerethi next, then the Mingreli and Guri, and more remotely the Suani and the Lazi, which reaches almost to Trebizond. A colony transported into Asterabad in Persia in 1622 is said to speak a purer idiom than any of those now spoken in Georgia. Georgian literature is mostly founded on that of Greece, with which country relations were very intimate, and it reached its highest development in the 17th and 18th centuries. The Bible was partly translated in the 8th century, finished in the 18th and splendidly printed at Moscow, Tiflis and Saint Petersburg. Arabic and European works have also been translated into Georgian. We can mention but a few of the many remarkable national works. Among the romances are the following: 'Tariel' (Of the Man in the Tiger

Skin), by Skhotta of Rusthvel, a general of the heroic queen Thamar, with a commentary by King Wakhtang VI (Tiflis 1793); 'Daredjamiani' (Deeds of Amiran, son of Daredjan, a hero of Bagdad), by the courtier Moses of Khoni; 'Visramiani' (Love of the Princess Vis for Prince Ramin), somewhat resembling Rousseau's 'Héloise'; 'Miriani' (story of the Chinese Princess Miri), imitated from the Persian. These and many others exhibit lively imagination and good taste. The 'Thamariani' is a panegyrical epic on Queen Thamar, by Tchakhakhadze. In poetry, there are versions of lyrical poems from the Greek, etc., by Georgi Aphoni (11th century); a collection of historic odes; there is also a very keen satirical work by Bessarion Gabas Khoili. The language is rich in folk-tales, fables and ballads, as well as in ecclesiastical writings. There are many histories of Georgia, chronicles, biographies, histories of families, monasteries, etc. The drama began to be cultivated at a late period, especially by Prince Eristov.

GEORGICS OF VIRGIL, The. This work followed the 'Eclogues' and preceded the 'Æneid.' They were completed in 30 B.C., when the poet was 40 years of age. Their composition extended over a period of seven years, and they are called Virgil's most finished poem, though they have not enjoyed the popularity of the 'Æneid.' Quintilian says that rarely were more than a few verses completed in a day, and Gellius and Donatus have preserved the poet's own statement that he begot and licked his verses into shape after the manner of a bear with her cubs. Dryden called the 'Georgics' «the best Poem of the best Poet.» Sellar says Virgil is the author of the only didactic poem the world cares to read. The word Georgics, *Georgica*, Γεωργικά, means in plain prose, «Things of the Farmer.» The poem consists of four books, with a total of 2,188 lines in hexameter. The first book contains a general treatment of the cultivation of the soil and the raising of crops. The subject of the second is the nurture of trees and the vine. The third discusses the care of the various animals belonging to the Italian farm. The fourth is devoted to the culture of bees. The subject was not new. Hesiod's 'Works and Days,' written upward of 1,000 years before Virgil's time, was almost as clearly the inspiration of the Georgics as the Homeric poems were of the 'Æneid' and Theocritus of the 'Eclogues.' Cato, who died in 149 B.C., had written a homely practical manual of agriculture which attains to the interest of literature only because of its antiquarian character and its author's fame. Even before Cato, a Carthaginian work on farming had been translated into Latin by order of the Senate. During Virgil's composition of the 'Georgics' themselves, Varro had written a treatise on agriculture in three books in the form of a dialogue. All of these and many more, especially Greek didactic works of the Alexandrian period, were known to Virgil, and contributed in greater or smaller measure to his information and inspiration. As might be expected, the 'Georgics,' in spite of their exquisite finish, suffer somewhat from lack of homogeneity. They are at the same time didactic and epic and lyric; they contain dull passages that have nothing poetic beyond their verse form, and passages of exceedingly beautiful and emotional description and story whose connection with the subject of agriculture is hardly more than a matter of suggestion. They are at the same time artificial and simple; they are full of sympathy with the life of the humble, and ornamented with barren Alexandrian conceits. They are at the same time scientific and superstitious; in them the facts of experience and the scientific doctrines of Lucretius and the Greek specialists alternate with the traditional lore of miracles and portents. They are at the same time the poem with a purpose, written at the suggestion of the court to encourage a «back to the soil» movement by glorifying the life of orchard and field and pasture, and the product of real poetic inspiration.

The inspirational quality of the 'Georgics' goes far toward compensating for their unevenness of texture. Many of the episodes in which the poem abounds are of the highest excellence. No one can forget the beauty of such passages as the story of Orpheus and Eurydice at the end of the fourth book, or the praise of country life at the end of the second, or the praise of Italy in the same book. It is this last passage which Andrew Lang has in mind when he speaks of «Virgil, in one splendid passage, numbering the glories of the land as a lover might count the perfections of his mistress.» Such is the splendor of digressions and episodes like these that the reader is carried over the more prosaic reaches without much loss of exaltation. They give the whole of the poem a strongly original and a strongly Roman character in spite of its many Greek features. It is full of the love of nature and of Italy, of sympathy with the simple manners, morals and religion of the farmer folk, of pride in the beneficent might of the Roman state. The 'Georgics' are really a national poem. Its object, aside from the æsthetic object of self-expression on the part of a poet whose heart was charged with love for a beautiful native land and pride in a great civilization, was, as Merivale says, «to recommend the principles of the ancient Romans, their love of home, of labor, of piety and order; to magnify their domestic happiness and greatness; to make men proud of their country on better grounds than the mere glory of its arms and the extent of its conquests.» If Virgil is the sacred book of the Romans, as Homer was of the Greeks, the Georgics may be called, in the phrase of Myers, «the Psalm of Italy.» The 'Georgics' may be read in the verse translation of Dryden, or the prose translations of Conington, Mackail and Fairclough. For appreciation, see article ÆNEID, THE.

GRANT SHOWERMAN.

GEOSYNCLINE, jē-ō-sin'klīn, a trough-shaped fold of the earth's crust, which affects the strata to great depths. It is similar to the syncline. The term was first employed by J. D. Dana, who inferred the existence of such folds from the presence of sedimentary strata in many mountain ranges. See FOLDS; GEOLOGY.

GEOTECTONICS. See STRUCTURAL GEOLOGY.

GEOTROPISM, jē-ŏt'rō-pizm, the influence which causes a tendency in plants and animals to grow toward the centre of the earth; it is defined by Dr. John Coulter as "sensitiveness to gravity." Geotropism in its simplest form, called "positive," causes growth directly downward, as in the tips of roots, which strike straight down into the earth. So strong is this influence upon roots that they will turn from any abnormal position in which they are placed and bend downward until they reach and penetrate the ground,— an adaptation for the preservation of plants against dislodgment by wind or water. The reverse of this is negative geotropism (apogeotropism), the influence which causes parts of plants, particularly stems, to grow *away from* the earth. A demonstration of these opposing influences in regulating plant-growth is found in the fact that when seedlings are caused to revolve continuously and rapidly for a period, their stems point and increase toward the centre of the centrifugal force, while the roots take the opposite line of growth. A third form of the tendency is called "diageotropism," and leads parts subject to its influence, as runners and rhizomes, to grow horizontally; that is, in a direction at right angles to the plane of positive geotropism. This influence is seen in the tendency of branches and foliage to assume a horizontal position. In all these cases, however, the result is modified and complicated by influences of sunlight, moisture, etc., styled heliotropism, hydrotropism, chemotropism, etc. (qq.v.); and sometimes, as in the case of twining plants, it is impossible at present to extricate them and assign to each its part in the result.

Geotropism, or the influence of gravity, has had a great effect, also, upon the forms of animals, especially in determining proportions and strength of parts with reference to weight. Associated with other influences it determines the "instinct" which leads many of the lower forms of life to seek the earth whenever possible, or at the proper time, a striking example of which is found in those caterpillars which, born in tree-tops, migrate to the ground as soon as born or when ready to begin their metamorphoses.

GEPHYREA, jĕf-ĭ-rē'a, worms allied to the chætopod annelids, but differing from them in not being segmented, though provided with bristles. The mouth is either surrounded with a circle of tentacles, or is overhung by a large broad "proboscis," which in the European *Bonellia* may be several times as long as the body and forked at the end. The vent is either terminal or situated dorsally on the anterior end of the body. They possess a true blood system similar to that of annelid worms. The young free-swimming larvæ of certain forms (*Echiurus*) are like the Trochophores (see LARVA) of ordinary annelids. The male of *Bonellia* differs remarkably in shape and size from the female, being only one millimeter in length, while the female measures three inches, with a proboscis from 8 to 12 inches in length. Our most common form is *Phascolosoma,* which is cylindrical, its mouth surrounded with tentacles, the vent opens near the head, it is without bristles, and lives in dead shells, building out the aperture by a conical tube of sand. Its larva is cylindrical, the head small, with a circle of cilia.

GEPIDÆ, jep'ĭ-dē, a people of Gothic origin who settled about the mouth of the Vistula in the 3d century. Before the 5th century they had migrated to the Lower Danube, where they were subjugated by the Huns; but, revolting against Attila's son, they recovered their freedom and established themselves in Dacia. There their power grew so great that they levied tribute from the Byzantine emperors down to Justinian's days. In the end of the 5th century a powerful enemy arose to them in the Ostrogoths; and after them came the Longobards, who, in alliance with the Avars, inflicted a crushing defeat on the Gepidæ in 566. A part of the last named then submitted to the Avars, while a part accompanied the Longobards to Italy. Henceforward they passed out of history.

GERA, gā'rä, Germany, a town in the principality of Reuss-Schleiz, on the right bank of the White Elster, 35 miles from Leipzig. Among the chief buildings are the castle, the old Trinity Church, the town hall (16th century), gymnasia, theatres, library, museum, town hospital, textile school, etc. It is the seat of important woolen manufactures; other industries being carpets, printing, machinery, brick and leather works, jewelry and nurseries. Gera was stormed by the Bohemians in 1450 and burned by the Swedes in 1639, and was again destroyed by fire in 1686 and 1780. Pop. 49,276.

GERACE, jā-rä'chā, Italy, city in Calabria, on the east slope of the Calabrian Mountains and the shores of the Ionian Sea, 34 miles northeast of Reggio, and 64 miles by rail. It is on the site of the celebrated Greek colony of Locri Epizephyrii. The cathedral, rebuilt in 1783, is partly of ancient materials. The district produces abundantly grapes, oranges, olives and grain; and coal, iron and marble are worked in the neighboring mountains. Pop. of commune, 11,009.

GERAH, gē'rä, the smallest piece of Hebrew money, being the 20th part of a shekel, or about three cents. Also, in Hebrew weights, a weight corresponding to the coin.

GERAINT, a king who figures prominently in the Arthurian legends. He appears in 'Geraint the son of Erbain,' the Mabinogion romance founded on Chrestien de Troyes's 'Erec et Enide,' and also in Tennyson's 'Geraint and Enid.'

GERALD DE BARRI. See GIRALDUS DE BARRI (CAMBRENSIS).

GERALDINI, jā-ral-dē'nē, **Allesandro,** the first Roman Catholic bishop of Santo Domingo: b. in Italy, 1455; d. in Santo Domingo, 1525. He was a soldier and served in the army of Spain against Portugal, 1475–76, before taking orders. His learning and his friendship with Archbishop Mendoza, of Toledo, procured for him the tutorship of the royal princesses of Castile. He had great influence in the Spanish court, and is said to have first interested Ferdinand and Isabella in behalf of Columbus. In 1520 he was made bishop of Santo Domingo, after having held many high places in Church and state. His residence and labors in the island, where he spent the remainder of his life, went far toward bringing law and order out of the chaos that followed upon the rule of the Spanish conquerors. His narrative of his journey thither and his description of Santo Domingo, printed in Latin (1631), is of great value and interest. He also wrote a life of Catharine of Aragon in verse.

GERANDO, zhä'rŏn'dō, **Joseph Marie,** Baron de, French author: b. Lyons, France, 29 Feb. 1772; d. Paris, 11 Nov. 1842. He became governor of Catalonia in 1812, and was professor of public law in the law faculty of the University of Paris from 1828 to 1842. His works, treating law, philosophy and other subjects, include 'Des signes et de l'art de penser' (1800); 'Histoire comparée des systèmes de philosophie' (1803); 'Institutes de droit administratif' (1829), and 'Cours normal des institutions judiciaries' (1839).

GERANIACEÆ, jē-rā-nĭ-ā'sę-ē, the geranium family, consisting of herbaceous plants or shrubs with opposite or alternate leaves, and white, red, yellow or purple flowers with five sepals and five petals. Eleven genera and about 500 species are known. They are found in temperate or hot climates, rarely in the arctic regions. They are often astringent and aromatic, abounding in vegetable oil.

GERANIUM, the typical genus of plants of the family *Geraniaceæ* (q.v.), having palmately lobed leaves, regular flowers and a five-lobed ovary, terminated by a long thick beak and five stigmas. On coming to maturity the carpels separate from the base and become resolute or spiral. The spotted crane's-bill (*G. maculatum*) is a very familiar species in the eastern and northern United States. The root is astringent and has been used medicinally. The tubers of *G. parviflorum* are eaten in Van Dieman's Land, where it is called the native carrot. Indian geranium is the name given by perfumers to a species of *Andropogon*. The so-called geraniums of gardens are mostly species of *Pelargonium,* and are natives of southern Africa. See Crane's-bill; Pelargonium.

GÉRARD, zhā'rär', **Balthasar,** French fanatic: b. Villafons, Franche-Comté, 1558; d. 1584. Taking the name of François Guion he joined the army of William of Orange and on 10 July 1584 assassinated the Prince at the entrance to the latter's palace at Delft. Gérard was put to death later in the same month. His family was ennobled by King Philip II.

GÉRARD, Cécile Jules Basile, French traveler: b. 1817; d. West Africa, 1864. He traveled much in Africa and earned for himself the soubriquet of «Gérard, the Lion-Killer.» His adventures in Algeria are described in 'La chasse aux lions' (1855) and 'Gérard, le tueur des lions' (1858). He set out on a tour of West Africa in 1863 and met his death there by drowning the following year.

GÉRARD, Conrad Alexandre, French diplomat: b. Massevaux, Upper Alsace, 1729; d. 1790. As a young man he entered the diplomatic service, serving as secretary of legation at Mannheim in 1753–59 and at Vienna in 1761–66. In the latter year he became secretary of the council of state and chief clerk in the Bureau of Foreign Affairs. In 1778, acting under Vergennes, he conducted negotiations with Franklin, Deane and Lee, the result of which was the treaty of 6 Feb. 1778 by the terms of which France sided with the United States. In the following month he sailed to America as first French Minister to the United States. In 1779 he was succeeded by Luzerne. He advocated a close alliance between France and the new nation and to this end subsidized many writers and congressmen. Yale conferred on him the degree of LL.D. After his return to his native country he was made a Councillor of State.

GERARD, Dorothea. See Longard de Longgarde.

GÉRARD, zhā-rär', **Etienne Maurice,** French marshal: b. Damvillers, Meuse, France, 4 April 1773; d. Paris, 17 April 1852. For his brilliant services at Austerlitz (1805) he was appointed general of brigade; he also took a notable part at Jena (1806), Erfurt (1806) and Wagram (1809). During the Russian campaign of 1812 he rendered conspicuous service at the capture of Smolensk in the battle of Valontina-Gora, and at the passage of the Beresina. In 1831 he commanded the French army sent to the assistance of the Belgians against the Dutch, whom he drove out of Flanders, and 27 Dec. 1832 compelled the citadel of Antwerp to capitulate. After the July revolution of 1830 he was appointed marshal and War Minister by Louis Philippe; he was again War Minister from July to October in 1834.

GÉRARD, François Pascal, a French portrait and historical painter: b. of French parentage, Rome, Italy, 11 March 1770; d. Paris, 11 Jan. 1837. At 10 he was brought to France, and at 16 became the pupil of David. In 1795 he exhibited 'Belisarius,' which first brought him into notice; shortly afterward he painted 'Psyche receiving the First Kiss from Cupid.' His portrait of Madame Bonaparte in 1790 was the beginning of his career as the «painter of kings.» Almost all the royal and other celebrities who visited Paris between 1799 and 1837 were painted by Gérard, who owed his success not alone to his skill as a portraitist, but also to the charm of his manners and conversation. His most celebrated portraits are those of Napoleon in his coronation robes, the Queen of Naples and her children, Talleyrand, Talma, Louis Philippe and Madame Recamier. The grandest of his works are, however, historical pictures, the 'Battle of Austerlitz' (1810) and the 'Entry of Henry IV into Paris' (1814). Gérard was appointed first court painter and made baron by Louis XVIII.

GERARD, James Watson, American diplomat and lawyer: b. Geneseo, N. Y., 1867. Educated at Wilson and Kellogg's School, New York city, Saint Paul's School, Concord, N. H., Columbia University and New York Law School, he was admitted to the bar in 1892 and commenced practising in New York, where he became counsel for several important corporations. He figured in a number of prominent cases and in 1907 was elected a justice of the Supreme Court of the State of New York for the term 1908–21. Mr. Gerard joined the National Guard of New York as a second lieutenant, was made captain in 1892, and served on the staff of Gen. McCoskey Butt in the Spanish-American War. In 1900 he was appointed quartermaster with the rank of major. He resigned his seat on the bench in July 1913, when President Wilson appointed him United States Ambassador to Berlin. The European War brought Mr. Gerard conspicuously before the public as the only representative of a great power left in Germany during the first two-and-a-half years of the conflict. The management of British interests in Germany were committed to his care when Sir Edward Goschen, the British Ambassador, left Berlin. In his last report to the Foreign Office (8 Aug. 1914) Sir Edward made special mention of «the great assistance rendered to us all by my American colleague, Mr. Gerard, and his staff. Undeterred by the hooting and hisses with which he was often greeted by the mob on entering or leaving the embassy, his Excellency came repeatedly to see me to ask how he could help us,» and that he had extricated many stranded British subjects from difficult situations «at some personal risk to himself.» For over two years it was Mr. Gerard's task to conduct the diplomatic negotiations between the American and German governments on the thorny problems of international law involved in the German submarine campaign and the Allies' blockade policy against Germany. During the time he also visited internment camps where British prisoners of war were held, and secured at least promises of improvement from the German military authorities in the treatment of British prisoners. These episodes and the numerous interviews he passed through with the Kaiser and German officials are described in the two books which he published in 1917 and 1918, 'My Four Years in Germany' and 'Face to Face with Kaiserism.' On 3 Feb. 1917 Count Bernstorff, German Ambassador in Washington, was handed his passports and Mr. Gerard was recalled from Germany. Two months later the United States declared war on Germany. Mr. Gerard retired from the diplomatic service in July 1917 and resumed his legal practice.

GERARD, John, English surgeon: b. Nantwich, Cheshire, 1545; d. 1612. He traveled much in early life and afterward settled in London, where he became superintendent of gardens to Lord Burghley, Queen Elizabeth's Secretary of State. In 1608 he was elected master of the company of barber surgeons. He was also famed as a botanist and in 1596 published a catalogue of 1,039 varieties of plants. In 1597 he published his 'Herball.' The genus Gerardia was named by Linnæus in his honor.

GERARD THE GREAT. See GROOT.

GÉRARD DE NERVAL, zhā'rär' de-när'-vä', the pen-name of GERARD LABRUNIE, a French author: b. Paris, 21 May 1808; d. there, 25 Jan. 1855. His first book to attract attention was a volume of poems, 'Élégies Nationales.' In 1828 he produced his translation of Goethe's 'Faust,' which brought him the author's personal approval and which Berlioz (q.v.) used largely as the score for his 'La damnation de Faust.' Gerard also wrote several original plays; was a regular contributor to various periodicals, and published 'Les illumines' and 'Contes et facéties' (1852), 'Scenes de la vie orientale' (1848–50). While insane he committed suicide. His writings were collected in five volumes in 1868.

GÉRARD DE RAYNEVAL, rā'nę-väl', **Joseph Mathias,** French diplomat: b. Massevaux, Upper Alsace, 1746; d. 1812. In 1767 he received his first appointment in the diplomatic service as chargé-d'affaires at Ratisbon, and two years later was removed to Dantzig in a similar capacity. In 1782 Vergennes sent him to England on a secret mission, which Franklin and the other American commissioners at Paris learned of, and suspected to be inimical to the interests of their country. This it was that impelled them to conclude a preliminary treaty of peace with England contrary to the instructions of Congress. In 1783–92 Gérard was French Minister to England, and filled the post admirably during a most critical period in the relations of the two countries. After 1792 he lived in retirement during the remaining years of the Revolution. Subsequently he engaged in journalism and studied history and international law. He wrote 'Institutions du droit de la nature et des gens' (1803). Consult Masson, 'Le départment des affaires étrangères pendant la révolution' (Paris 1877).

GERARD THOM (and variously also TUNC, TUM, or TENQUE), Italian monk, founder of the order of the knights hospitallers of Saint John of Jerusalem: b. Amalfi, about 1040; d. 1120. In the latter part of the 11th century he first visited Jerusalem, and while there was appointed the superior of a hospice for the convenience of pilgrims, and there he organized the religious order afterward so celebrated, duly recognized by a bull of Pascal II in 1113.

GÉRARDMER, zhā'rär'mär', France, capital of a canton in the department of Vosges, on Gérardmer Lake, 35 miles east of Epinal. It has linen and cheese manufactories and is a favorite summer resort because of its splendid location in the mountains. It was so named from Gérard of Alsace, who built a tower here on the lake shore in the latter half of the 11th century. Pop. 10,500.

GERARDO DALLE NOTTI, jā-rär'dō däl-le nōt'tē. See HONTHORST, GERARD VAN.

GERARDY, zhę'rär'dē', **Jean,** Belgian musician: b. Spa, 1877. In 1884 he began the study of the violoncello under Bellmann, and in the following year entered the Verviers Conservatory of Music. By 1888 he had become a finished virtuoso and left the institution. In the same year he made his début in London, appearing the same night with Paderewski and Ysaye. He next toured Belgium, Holland, Germany, Russia and France. He visited the United States in 1899, where he appeared with Ysaye, Kreisler, Marteau and others. He made several subsequent visits to America, appearing in 1914 with Ysaye and Godowsky.

GERASA, jer'ā-sā, Palestine, an ancient city of Palestine, 20 miles north of Philadelphia and a like distance east of the Jordan. In 83 B.C. it was captured by Alexander Jannæus, and was rebuilt by the Romans in 65 B.C. In the reign of Vespasian it was taken and burned by Lucius Annius. It was once the seat of a Christian bishop, but soon sank into decay. The modern name is Jerash. The ruins of the old city are extensive, many fine columns and walls attesting its former splendor. Consult photographs of the ruins published by the Palestine Exploration Fund (1867).

GERBA. See JERBA.

GERBER, gär'ber, **Ernst Ludwig,** German musical authority: b. Sondershausen, Germany, 29 Sept. 1746; d. there, 30 June 1819. He published 'Historische-biographisches Lexicon der Tonkunstler,' a work which, commenced in 1790, was not completed until 1814.

GERBER, Johann Gottfried Heinrich, German engineer: b. Hof, Bavaria, 1832; d. 1912. He received his education at Nuremberg and Munich. He was a successful designer of bridges and originated the "cantilever system" which was patented by him. The bridge over the Isar at Grosshesselohe was designed and constructed by him. The original cantilever bridge by him is that at Regnitz. He wrote 'Die Rheinbrücke bei Mainz' (1863); 'Die Isarbrücke bei Grosshesselohe' (1859); 'Das Paulische Trägersystem' (1859); 'Träger mit freiliegenden Stützpunkten' (1870).

GERBERS. See GUEBERS.

GERBERT. See SILVESTER II.

GERBERT, Martin, BARON VON HORNAU, German Roman Catholic prelate: b. Horb, 1720; d. 1793. He was educated at the Jesuit school of Freiburg in Breisgau, entered the Benedictine order in 1737 and became a priest in 1744. Subsequently he became professor of theology and abbot of the monastery in 1764. In 1759–62 he traveled throughout Europe seeking out old collections of musical literature housed in the monasteries. He wrote 'De Cantu et Musica Sacra' (1774). 'Monumenta Veteris Liturgiæ Alemannicæ' (1777); 'Scriptores Ecclesiastici de Musica Sacra' (3 vols., 1784), his greatest work and still of the highest value for the historian of musical literature; 'Codex Epistolaris Rudolphi I' (1772); 'Historia Nigræ Silvæ Ordinis Sancti Benedicti' (1788). Consult the life by Misard (Paris 1867).

GERCKE, gär'kę, **Alfred,** German scholar: b. Hanover, 1860. He received his education at the universities of Bonn and Berlin, and in 1886–88 he was professor at the Luisen Gymnasium of Berlin. He became privat docent at Göttingen in 1890, remaining until 1893. From 1895 to 1909 he held a professorship at Greifswald, and in the latter year removed in a similar capacity to the University of Breslau. He published numerous works on the writers of antiquity, including 'Seneca-Studien' (1895); 'Studia Annæana' (1900); 'Griechische Litteraturgeschichte (1898; latest ed., 1913); 'Geschichte der griechisch-römischen Philosophie' (2d ed., 1912); 'Methodik' (1912); 'Einleitung in die Altertumswissenschaft' (2d ed., 1912), in collaboration with Norden; 'Entstehung der Æneis' (1913).

GERDA, jĕr'dä. (1) In Scandinavian mythology, wife of Freyr and daughter of the giant Gymer; she is so beautiful that the brightness of her naked arms illuminates both air and sea. (2) In astronomy, an asteroid, the 122d found; discovered by Peters, 31 July 1872.

GEREZ, hā'rĕs, **Sierra de,** Portugal, a mountain chain which ramifies from the mountains of Asturias and stretches between the basins of the Douro and Minho, from north to south, for about 18 miles. It consists generally of a succession of granite peaks, the loftiest of which, Murro de Burageiro, has a height of 4,296 feet.

GERFALCON, or **GYRFALCON.** See JERFALCON.

GERGONNE, ger'gun, **Joseph Diez,** French mathematician: b. Nancy, 1771; d. 1859. He joined the army in 1792 and was attached to the Moselle division, taking part in the celebrated battle of Valmy. After a brief course at the Chalons artillery school he was commissioned lieutenant and took part in the campaign in the Pyrenées. Returning to Nimes, he was made professor of mathematics at the École de Nimes; removed to Montpellier in 1816 as professor of astronomy, and in 1830 became rector of the academy there. His fame rests on his being one of the founders of modern projective geometry and his enunciation of the principle of geometric duality. He published *Annales de Mathématiques* from 1810 to 1831.

GERGOVIA, the modern Gergovie, and in Roman times the capital of the Arverni. In 52 B.C. Julius Cæsar made an unsuccessful attack against it. Consult Holmes 'Cæsar's Conquest of Gaul' (2d ed., 1911).

GERHARD, gär'härt, **Eduard,** German archæologist: b. Posen, 1795; d. 1867. He was educated at Breslau and Berlin, and after 1816 resided in the former city. He became professor at the Gymnasium of Posen in 1816 and remained there three years. Failing eyesight led to his resignation, and he set out for Italy. From 1822 to 1837 he resided in Rome and prosecuted there his archæological studies. He became archæologist of the Berlin Museum in 1837, became professor of the University there in 1844, and was made a member of the Royal Academy. He was one of the founders of the Institute di Corrispondenza Archeologica, later the Imperial German Archæological Institute. He gave a great impetus to archæological study by promoting an orderly classification and publishing seriatim important groups of monuments, artistic remains, etc. Many of his papers are found in the Gesammelte academische Abhandlungen und kleine Schriften' (Berlin 1866–68). His published works include 'Rapporto intorno i vasi Volcenti' (1831); 'Antike Bildwerke' (1844); 'Auserlesene griechische Vasenbilder' (1839 et seq.); 'Griechische und etruskische Trinkschalen' (1843); 'Etruskische und campanische Vasenbilder' (1843); 'Apulische Vasen' (1846); 'Trinkschalen und Gefässe' (1850); 'Etruskische Spiegel' (4 vols., 1843–68; 5th vol, by Klugmann et al., 1897). Consult Jahn, 'Eduard Gerhard, ein Lebensabriss' (Berlin 1868), and Sandys 'A History of Classical Scholarship' (Vol. III, Cambridge 1908).

GERHARD, William Paul, American sanitary engineer: b. Hamburg, Germany, 30 July 1854. He was educated in Alexandria, Egypt, and later on in Germany; was graduated at Technical University of Karlsruhe, Baden, and served as volunteer in Prussian Railroad Regiment, 1875–76, Berlin. He came to the United States in 1877, and received honorary degree of doctor of civil engineering from Technical University of Darmstadt, 1911. He worked under Colonel Flad and under Captain James B. Eads in Saint Louis, 1877–80; became chief assistant engineer to Col. George E. Waring, Jr. at Newport, 1881–83, and has since practised his profession in New York. He was editor of *Building,* an architectural journal, 1885–86; served as consulting sanitary engineer on staff of New York State architect. Was United

States delegate to First International Conference on Public Baths at The Hague, 1910. Member of technical societies and author of numerous American works on sanitation, house drainage, water supply, fire protection, gas lighting. Has also published three German works.

GERHARDT, Dagobert von. See AMYNTOR, GERHARD VON.

GERHARDT, Eduard, German painter: b. Erfurt, 1813; d. 1888. He began life as a lithographer, next studied architecture at Cologne and under Semper at Dresden. In 1837 he took to painting at Munich, and subsequently studied his art in Italy and the Iberian Peninsula. For some time he was an instructor in the royal household at Lisbon, but in 1851 returned to Munich. His portrayal of Moorish architecture is unrivalled. His most notable works are 'Palace of the Inquisition at Cordova' (1863); 'Lion Court at the Alhambra, Granada' (1861); 'Saint Marc's, Venice' (1864), all in the Pinakothek, Munich; 'The Alhambra by Moonlight'; 'Generalife' and 'The Comares Tower,' in the Schack Gallery, Munich.

GERHARDT, Elena, German singer: b. Leipzig, 11 Nov. 1883. In 1899 she joined the Leipzig Conservatory, and for four years studied there under Marie Hedmont. In 1903 her début in a recital at Leipzig was an instantaneous success and by popular demand she was induced to try opera. After eight appearances at Leipzig she decided to confine her efforts to concert work. She soon became known as the greatest lieder singer of modern times. In 1912 she visited the United States and made a most successful concert tour with the principle orchestras. In 1913 she reappeared in America and the entire country did homage to her genius.

GERHARDT, Karl, American sculptor: b. Boston, Mass., 7 Jan. 1853. He was a machinist at Chicopee, Mass., and he showed considerable talent in this field, in which he later became a designer of machinery at Hartford. He became interested in sculpture and he was so successful that he was ultimately sent to study in Paris, where his work was exhibited in the salon and won prizes. His works include busts of Gen. U. S. Grant, Henry Ward Beecher, Samuel L. Clemens, etc.; and statues of Nathan Hale, in the Connecticut State capitol; Gen. Israel Putnam at Brooklyn, Conn., and other Americans of note.

GERHARDT (Fr. zhâ-rär'), **Karl Friedrich,** French chemist: b. Strassburg, 21 Aug. 1816; d. there, 19 Aug. 1856. He studied chemistry under Leibig at Giessen. In 1838 he went to Paris, where he lectured on chemistry, and there with his friend Cahours he commenced his researches on the essential oils. In 1844 he was appointed professor of chemistry at Montpellier. About this time he published his 'Summary of Organic Chemistry.' In 1848 he resigned the chair and returned to Paris to devote his time and energies to chemical investigations. His works attracted world-wide attention, and resulted in his becoming, in 1855, professor of chemistry at Strassburg. His ideas and discoveries are embodied in his 'Treatise on Organic Chemistry' (1853–56). Consult Grimaux, 'Charles Gerhardt' (Paris 1900); Ostwald, 'Grosse Männer' (Leipzig 1909).

GERHARDT, Paul, German hymn-writer: b. Gräfenhainichen, Saxony, 1607; d. Lübben, 7 June 1676. He studied at Wittenberg, and became pastor at Mittenwalde. Removing to Berlin in 1657, he became deacon at the Nicolaikirche, where he remained until 1666, when he was deprived of his office because of his refusal to accept the dict of Frederick William. Later this deprivation was annulled through popular intercession, but Gerhardt would not compromise, and remained for a time without employment. In 1668 he became archdeacon at Lübben, where he remained until his death. He was staunch in his support of the Lutheran doctrines, and defended them ardently against the Reformed Churches. He is especially renowned for his hymns, ranking in that field with Luther. They were published first in hymn-books, but the earliest complete set is the 'Geistliche Annalen' (1666–67) with music by Ebeling. Consult critical editions by Bachmann (Berlin 1866) and the Goedeke (Leipzig 1877); and the 'Life' by Langbecker (Berlin 1841). The best modern editions are by Wackernagel (1843), which has gone through many editions, and an English translation by Kelley, 'Paul Gerhardt's Spiritual Songs' (1867).

GERHARDUS MAGNUS. See GROOT.

GERHART, Emanuel Vogel, American German Reformed clergyman: b. Freeburg, Snyder County, Pa., 13 June 1817; d. Lancaster, Pa., 6 May 1904. He entered the ministry in 1842, was president of Tiffin College, Ohio, 1851–55, and of Franklin and Marshall College, Lancaster, Pa., 1855–66; and professor of theology at the theological seminary at Lancaster from 1868. He published 'Philosophy and Logic'; 'Institutes of the Christian Religion' (1891).

GERI (gā'rē), and **FREKI,** frā'kē, the wolves attendant on Odin's throne in Valhalla. When he feasts with his heroes, having no need of food, he gives all the viands placed before him to his faithful attendants, Geri and Freki.

GERIATRICS. See OLD AGE AND ITS DISEASES.

GERICAULT, zhā'rē-kō', **Jean-Louis André Théodore,** French painter: b. Rouen, 26 Sept. 1791; d. Paris, 18 Jan. 1824. He was educated at the Lycée Louis-le-Grand, studied art under Vernet and Guérin. He exhibited at the salon of 1812 his 'Cavalry Officer on Horseback' (now in the Louvre) and his reputation was at once established. In 1814 followed his 'Wounded Cuirassier,' which was only moderately successful. The artist now joined the army and served for some time at Versailles. He went to Italy in 1817 and studied the great masters there. His work was profoundly influenced by his stay in Italy. 'The Raft of Medusa' belongs to this period of his career and is one of the great world masterpieces. It was exhibited by the artist in England and brought $4,000. His stay in England produced the 'Race for the Derby at Epsom,' his last big work. In the Louvre, at Rouen Museum at Paris and elsewhere are numerous sketches, lithographs, bronze models, etc. A fall from a horse in 1822 greatly injured his frame and his last two years were spent in great bodily distress. Consult Clément 'Géricault: Etude biographique et critique' (Paris 1868); Muther, 'History of Modern Painting' (London 1907); Brownell, 'French Art, Classic and Contemporary' (New York 1901).

GERICKE, gā'rik-e, **Wilhelm,** German orchestra leader: b. Gratz, Austria, 1845. He entered the Vienna Conservatory in 1862 and in 1865 became kapellmeister of the Linz theatre. In 1874 he became record kapellmeister of the Vienna Court Opera under Hans Richter. In 1880 he succeeded Brahms as conductor of the Gesellschaftsconcerte and subsquently became conductor also of the Singverein. In 1884–89 as leader of the Boston Symphony Orchestra he made it one of the great orchestras of the world. From 1889 to 1895 he was back at his old post in Vienna but in 1898 returned to Boston and until 1906 was in charge of the orchestra there. He retired in the latter year. He has published a number of works for orchestra, also pianoforte works, and some chamber music.

GERIG, gā'rig, **John Lawrence,** American educator: b. Columbia, Mo., 1878. In 1898 he was graduated at the University of Missouri, and subsequently studied at the University of Nebraska and at Paris. In 1901–03 he was instructor at the University of Nebraska and in 1905–06 at Williams College. From 1906 to 1911 he was successively lecturer, tutor, instructor and assistant professor of Celtic and the Romance languages. In 1911 he became associate professor at the same institution. He collaborated in Edgren's 'Italian Dictionary' (1902) and contributed to encyclopedias, and was also associate editor of the *Romanic Review.*

GERING, Ulrich, Swiss printer: b. about 1440; d. 1510. Under direction of Guillaume Fichet, rector of the Sorbonne, and in conjunction with Michael Friburger and Martin Crantz he set up the first printing press ever set up in France.

GERIZIM, ger'i-zim, one of the highest mountains in the central Palestine chain (3,000 feet), separated from Ebal Mountain by a deep narrow valley, in which stands the town of Nâblus. The valley between them is very fertile. Jacob's well stands where the vale joins the plain of Moreh. Mount Gerizim (with Mount Ebal) was the scene of an imposing ceremony after the crossing of Jordan, in which the entire people of Israel took part, in obedience to a command which Moses had given them. (Deut. xxvii). The Samaritans built a temple on Mount Gerizim as a rival to that of Jerusalem, and organized a rival priesthood; and the Samaritan Pentateuch closed the Decalogue with the injunction, «Thou shalt build a temple on Mount Gerizim, and there only shalt thou worship.» And, though the Samaritan temple was destroyed by Hyrcanus about 200 years after, the mountain on which it stood continued to be held sacred by the Samaritans. It was to Mount Gerizim that the «woman of Samaria,» referred when she said to our Saviour; «Our fathers worshipped in this mountain, and ye say that in Jerusalem is the place where men ought to worship.» The Samaritans claim that Gerizim was the scene of the sacrifice of Isaac, and on its summit the Samaritan passover is solemnized. See EBAL.

GERLAND, gär'länt, **Ernst Wilhelm Ferdinand,** German Byzantine scholar: b. Imshausen, Hesse-Nassau, 19 May 1870. He was educated in the public schools of Partschendorf and Fulnek, the gymnasia at Troppau, Silesia and Halberstadt, Prussia, and the universities of Berlin and Jena. In 1893 he took up his duties as teacher at the gymnasium of Homburg von der Höhe, being made professor five years later. For many years he has been engaged in editing the collections of Gelzer 'Teilnehmerlisten der ältern Konzilien,' and 'Notitiæ episcopatuum' for the Prussian Academy of Sciences under the title, 'Corpus notitiarum episcopatuum ecclesiæ orientalis Græcæ,' in collaboration with August Burckhardt, Nicola Radojšić, and Peter Thomsen. Under the auspices of the Schönhauser Fund he traveled for special studies to the Institute for Austrian Historical Research, Vienna, and to the archives and libraries of Venice and Macerata in 1897–98, and to Florence in 1900. He is the author of 'Das Archiv des Herzogs von Kandia im königlichen Staatsarchiv zu Venedig' (1899); 'Geschichte des lateinischen Kaiserreiches von Konstantinopel' (1905); 'Histoire de la noblesse crétoise' (1907; Italian trans., 'Bolletino araldico,' 1908). He collaborated in 'Historisches Jahrbuch der Görres-Gesellschaft' (1899); 'Neue Jahrbücher für das klassische Altertum' (1902–04); 'Scriptores sacri et profani' (1903); Krumbacher 'Byzantinische Literaturgeschichte'; 'Mitteilungen des Vereins für Geschichte und Altertumskunde zu Homburg von der Höhe.' He contributed to the 'Catholic Encyclopedia,' the *Byzantinische Zeitschrift, Revue de l'Orient latin, Literarische Centralblatt, Berliner Philologische Wochenschrift, Historische Zeitschrift,* etc., etc.

GERM or **MICROBE,** a term applied to any microscopical form of life, plant or animal, any individual micro-organism that has been found to have a life history. Vegetable germs are recognized as the causes of fermentation and putrefaction. They are nature's scavengers. At one time in the given theory of disease most of the communicable or infectious diseases were thought to be spread by microbes or germs of animal origin, but the study of these diseases in recent years show that both lowly organized plants and animals may be the sources of infection. Diseases caused in this way are known as germ diseases. It is known that malaria, for example, is caused by parasitic germs brought into the blood by mosquitoes, and typhus fever by body lice, while typhoid fever, acute pneumonia, infantile paralysis or poliomyelitis, and tuberculosis for example are caused by microscopical vegetable growth, known as bacteria. The microscopic plant has in itself the seed or power of reproducing a plant of like kind. As Tyndall puts it «as surely as a thistle rises from a thistle seed, as surely as the fig comes from the fig, the grape from the grape, the thorn from the thorn, so surely does the typhoid germ (or seed) increase and multiply into typhoid fever, the scarlatina germ into scarlatina and the small-pox germ into small-pox.» While the infecting germ of measles and of some other communicable discases has not yet been isolated and studied, progress is being made toward their discovery. Plants as well as man and other animals have diseases, and probably there is no living animal or plant that does not have to struggle directly or indirectly with either plant or animal germs. Fortunately while ordinary atmospheric air frequently contains many germs, they are content usually to live on dead plants and animals — and even so-called disease germs may be harmless to human beings in a good condition of general health. But when an individual has a depressed vitality, there is a suitable soil for the development and propagation of disease germs. They now live on live tissues. It is estimated that in suitable soil one bacterium in 24 hours will have 17,000,000 descendants. Germs enter the body through the nose by inspired air, by the throat with air and infected food, and through abrasions and wounds of the skin. Excreted from the body they can convey infection to others. It is now recognized that germs of diphtheria, typhoid fever and infantile paralysis for example, finding lodgement in the bodies of healthy persons, may through the excretions from these bodies produce infection for others. These persons are designated «carriers.» Dust is a great holder of certain disease germs, so are articles of food and clothing, bedding, carpets, any decomposing material, etc. In the prevention and treatment of infectious or germ diseases, civic, house and personal cleanliness are of prime importance. See MICROBES; INFECTION; DISEASE, GERM THEORY OF; PLANTS, DISEASES OF; PARASITES; BACTERIA; PROTOZOA.

GERM CELLS. See CELL; EMBRYOLOGY.

GERM-LAYER THEORY. See EMBRYOLOGY.

GERM-PLASM, *in biology,* the protoplasm peculiar to a germ or ovum. The power of propagation depends upon the possession of germ-plasm, which is the means of preservation of species. In unicellular organisms the germ-plasm is contained in the cell that constitutes the body, but in multicellular animals and plants there are distinct germ-cells, out of which the new individual is formed. The plasm of those cells Weismann calls *germ-plasm,* which is therefore the actual bearer of the phenomena of heredity. Upon this fact he based his well-known theory of the continuity of germ-plasm. Nägeli gave it the name of *ideoplasm.* See BIOLOGY; EMBRYOLOGY; WEISMANN, AUGUST.

GERM THEORY OF DISEASE. See DISEASE, GERM THEORY OF.

GERMAIN-EN-LAYE, zhĕr'măṅ-äṅ-lē', **Saint.** See SAINT GERMAIN-EN-LAYE.

GERMAN ART. See GERMANY — ARCHITECTURE; PAINTING; SCULPTURE.

GERMAN BAPTIST BRETHREN, known also as «Dunkards,» «Dunkers» or «Tunkers,» bodies of Christians of German origin, consisting of four divisions. (1) Conservative, (2) Old Order, (3) Progressive, (4) Seventh Day. The movement, a distinguishing feature of which is baptism by trine immersion (candidates are dipped at the utterance of each title in the Trinity — Father, Son, Holy Ghost — in the formula), arose in Swartzenau, on the Oder, in Germany, near the beginning of the 18th century (1708), Alexander Mack, a miller, being the founder. It was mystical and pietistic in character, and its members, rejecting formulated creeds, turned to the Bible as their only rule of faith and practice, and for nearly two centuries strict adherence to the letter of the Scriptures has been observed. Religion is carried into all the affairs of life and business and social relations, as well as into all church matters; and fellowship, worship, work, conduct as individuals in all things were regulated by decisions of the annual conference, based upon passages of the Word of God. Nonconformity to the world was applied as a principle to the whole body of the Brethren in the United States, until the last quarter of the 19th century, when the influence of other Christian bodies and of general education broke down exclusiveness, and let in some of the spirit of the world, giving rise to the first three divisions, Conservative, Progressive and Old Order, described below. Under the dominance of this principle, the costumes of both men and women, the manner of wearing the hair and beard were prescribed, and fashion's decrees set at naught. Bonnets for women, hats for men, carpets for the floors, pianos or organs in the house, and many other things were resisted successfully for many years, in one way or another. When articles of wear and use became common the rule was gradually relaxed. At first colleges were forbidden and for a time high schools were under the ban, the text supporting it being Romans xii, 16, «Mind not high things, but condescend to men of low estate.» Nevertheless, high schools and colleges came a little later, and are carried on both in the Conservative and Progressive branches. Like the Mennonites and Friends, the Brethren are opposed to war and to the taking of juridical oaths and restrain their members from litigation.

The Dunkards suffered persecution in Wittgenstein and removed to Crefeld and to other places in Germany, Switzerland and Holland. But their practices differing from those generally prevailing, the atmosphere became unfriendly almost everywhere, and emigration to the United States, beginning in 1719, soon brought large companies of the Brethren to this country. Most of them settled in Pennsylvania, whence they found their way gradually to the South and West. One of their number set up a printing house in Germantown, Christopher Saur, from whose press was issued the first Bible in German printed in America.

Among the peculiarities of the Brethren is the observance of the communion as an evening meal, accompanied by the ceremony of foot-washing, the giving of the holy kiss, and the use from the first of unfermented wine. Participation in slavery, in the making, selling or drinking of intoxicants, was forbidden before the close of the 18th century; also the use of tobacco, membership in secret societies, the taking of juridical oaths, and activity in politics.

The Brethren are simple, plain-living, devout Christians of the evangelical type, carrying on their church work in much the same way as other denominations, their form of church government being congregational among the Progressives and Old Order Brethren, with some modification among the Conservatives, who give some ecclesiastical power to the annual conference.

The customs, manners and methods of life of the communities of which the Brethren formed a part, gradually took effect among them, giving rise to differences of opinion on questions relating to nonconformity, and finally precipitating divisions into Progressive, Conservative and Old Order branches. The Old Order Brethren, the strictest of the three in matters of discipline, withdrew in 1881 as a protest against relaxation; the next division occurred in 1882 when the Progressive Brethren withdrew because the main body was not sufficiently liberal in discipline, according to their thinking, and especially because it had departed from the congregational principle of church government.

The Conservatives, calling themselves German Baptist Brethren, who became a separate body in 1881, are by far the most numerous branch. In addition to the annual conference, a great event among them, there are 40 or more district conferences, whose business is local in character. They have colleges and collegiate institutes, carry on home and foreign missions, conduct Sunday schools, and have a large publishing business. In 1916 it reported 100,000 members, with 980 churches and over 3,000 ministers, including deacons, elders and bishops. The bishops are local church officials of the highest order. The territory covered by the Church embraces 35 States, stretching from New York west to the Pacific and from the Canadian border to the Gulf.

The Progressives, who have adopted the name Brethren Church for their organization, differ from the Conservatives in the stress they lay on the congregational system and in matters of discipline. All ecclesiastical power is lodged with the local church. They have district conferences and a general conference, which have no ecclesiastical functions. This body maintains a university at Ashland, Ohio, is active in missionary work, promotes Sunday schools and has societies of Christian Endeavor. It had in 1916, 24,794 members, 230 churches and 314 ministers. It is increasing slowly.

The Old Order Brethren, dating from 1881, were organized to preserve, from the inroads of modern social life and customs the church of the fathers. They insist upon non-conformity, hold that marriage is indissoluble, and observe the simple life, dressing plainly and living quietly. They are not growing in numbers. They reported in 1916, 3,500 members, 70 churches and 219 ministers. They do not conduct missions, nor Sunday schools.

The German Seventh-Day Baptists began their history when John Conrad Beissel withdrew from the Brethren because he had been led to adopt the Seventh day as the Sabbath and the principle of celibacy. This was in 1728. Four years later, he took up the life of a hermit at Ephrata, Pa., where he organized a celibate community, known as the Ephrata Society. Two houses were built, one for the sisters, with a prioress in charge, and one for men, with a prior. A school was established in 1735 and a printing house in 1750. As a celibate community the society began to dwindle, celibacy was dropped and by 1830 the members had been scattered and community life was abandoned. In belief, these churches are in general harmony with the other bodies of Brethren, differing somewhat in practice. In 1906 they reported 167 members; in 1916, 300, with 15 ministers, and 6 churches.

The four bodies had in 1916 a total of 3,645 ministers, 1,295 churches and 128,594 members. Consult Brumbaugh's 'History of the German Baptist Brethren in Europe and America' (Elgin, Ill., 1899), Falkenstein's 'History of the German Baptist Brethren Church' (Lancaster, Pa., 1906).

H. K. Carroll.

GERMAN CATHOLICS, a religious sect which sprang up in Germany about the close of 1844, which rapidly increased during the four or five following years and then as rapidly declined. The immediate cause of the formation of this sect was the exhibition by Arnoldi, bishop of Trèves, of the holy coat preserved in the cathedral of that city and said to be the coat of Christ. The bishop accompanied the exhibition of the holy coat by a promise of plenary indulgence to whoever should make a pilgrimage to Trèves to honor it. The announcement of this proceeding on the part of the bishop of Trèves produced a feeling of general astonishment in Germany and drew from a Silesian priest called J. Ronge, who had already been suspended from his charge on account of his independent views, a letter protesting against the exhibition of the holy coat and denouncing the projected pilgrimage as idolatry. This letter was published in the 'Sächsische Vaterlandsblätter' on 16 Oct. 1844, and produced an amount of excitement that was quite unanticipated by the writer. Ronge was excommunicated, but this only increased the general enthusiasm in his favor, and when he entered into relations with Czerski, another independent priest who had seceded from the Church, and made along with him an appeal to the lower grades of the clergy to unite in founding a National German Church independent of the Pope and governed by councils and synods, the appeal received a ready answer from a considerable number of those to whom it was addressed. A number of congregations belonging to the new body were formed in the more important towns, especially in Leipzig, under the celebrated Robert Blum, and in Magdeburg under the teacher Kote. In the spring of 1845 there were already about 100. At this time (March 1845) a council was summoned to meet in Leipzig to deliberate on the affairs of the body. Only 20 congregations were represented there, but these nevertheless at once proceeded under the presidency of Professor Wigard to arrange a system of doctrine and practice which was to form the basis of union for the whole Church. The Bible was recognized as the sole standard of faith and its interpretation was left to reason, «penetrated and animated» by the Christian idea. Only two sacraments were admitted, baptism and the Lord's Supper. In matters of ritual each congregation was left free to carry into practice its own views. The organism of the new Church was almost the same as that of the Presbyterian dissenting churches of Scotland. Each congregation was to choose its own pastor and elders. Affairs of a general interest were entrusted to the management of a general council to meet every five years, but the decisions of this council were to be ratified by a majority of the congregations before they came valid. The confession of sins, the hierarchy of the clergy and the celibacy of the priests were abolished and the authority of the Pope was not recognized. On the subject of purgatory nothing was declared either for or against it. The constitution of the new Church was thus a Protestant one, but in some respects the German Catholics went even further than the majority of Protestants in a liberal direction, inasmuch as they claimed for all, complete religious liberty and declared their religion to be capable of development and modification with the progress of the human mind.

The Church established on this basis had at first, as has already been stated, great success. The most eminent men of the liberal party regarded the movement with sympathy, or at least with interest. Gervinus expressed his belief that great benefits might result from it. Many Protestants, dissatisfied with the subjection of their religion to state supervision, joined the body, which, at the end of 1845, counted 298 congregations. But it was not long before the spirit of opposition began to show itself. The majority of the governments in Germany at the instigation both of the Protestant and the Roman Catholic clergy began to use repressive measures against the new body. Prussia contented itself with regulating the exercise of their worship; but some of the other states went further. At Baden the adherents of the sect were deprived of their political rights. Austria took the course of banishing them from her dominions. But persecution from without did less hurt than the divisions within the body. Almost immediately after the meeting of the council at Leipzig a congregation had been formed at Berlin which refused to abide by its decisions. Czerski and Ronge, the two originators of the sect, became the leaders of two opposing parties within it, one of which, that headed by Czerski, clung to the traditions and doctrines of the Roman Catholic Church, rejecting only the supremacy of the Pope and the union between Church and State; while the other sought for more freedom, converted religion into a sort of popular philosophy and began to mix up with it questions of politics, exhibiting strong democratic tendencies. These were most plainly manifest during the revolutionary epoch of 1848. The schism between the two parties was then complete. One section of the congregations of German Catholics professed to have only religious ends in view, while another section openly pronounced itself in favor of socialistic principles.

From the year 1850, however, there were several attempts to re-establish the unity of the body. An effort was made to reintroduce harmony by widening the basis of union. Instead of founding a religion, a council held at Gotha in June 1859, proposed the formation of a religious association or confederation into which all free Protestant and even Jewish congregations were to be admitted. Legislation in the different states had become more tolerant and the carrying out of the scheme of the council of Gotha seemed to be at least practicable. But the result proved otherwise. The associations consisted of too heterogeneous elements. While some of the members receding further and further from orthodoxy proclaimed simple design as their religion and abolished baptism and the Lord's Supper, others on the contrary lost themselves in an exaggerated mysticism. According to the most recent statistics there are still about 100 congregations of German Catholics in Germany; but their numbers only amounted to about 6,200 in 1895. Consult Bauer, 'Geschichte der Gründung und Fortbildung der deutschkatholischen Kirche' (Meissen 1885); Kampe, 'Wesen des Deutschkatholicismus' (Tübingen 1850); Findel, 'Der Deutschkatholicismus in Sachsen' (Leipzig 1895).

GERMAN CLASSICAL SCHOOL OF POLITICAL ECONOMY. See ECONOMICS.

GERMAN COMMERCIAL COLLEGES. See COMMERCIAL EDUCATION.

GERMAN EAST AFRICA, the largest German colonial possession, extending from lat. 1° to about 11° 41′ S., and from long. 29° to 40° 40′ E., acquired between 1885–90. It has a coast line of 620 miles and lies between British East Africa, Indian Ocean, Portuguese East Africa, Rhodesia, Kongo Free State and the British Sudan. The area is 384,000 square miles. The German Empire is represented by an imperial governor, who appoints a council of five in each of nine communes. The region produces almost every kind of tropical fruit, fibres, sugar, tea, copra, vanilla, rubber, cotton, cinchona, etc., and cattle rearing is extensively carried on. The chief seaports are Dar-es-Salaam (pop. 13,000); Bagamoyo (pop. 14,000); Saadani, Pangani, Kilwa (pop. 10,000 each), and several smaller towns. Fine roads have been built and two railroads are operated. Tanga to New Moshi, 220 miles, and Dar-es-Salaam to Ujiji, 780 miles. There are 51 post offices, 34 telegraph stations, and wireless stations at Dar-es-Salaam, Muansa and Bukoba. The native population, chiefly Banhi tribes, is 7,659,900; foreign colored, Arabs, Syrians and Loanese, 14,900; and white, 5,340, of whom 4,100 were Germans. Attacked by South African and British forces under General Smuts, from the north, and by Belgian and Portuguese from the south and west in 1917, the colony came under the control of the Allied nations.

GERMAN EMPIRE. See GERMANY.

GERMAN FURNITURE. See FURNITURE, MEDIÆVAL.

GERMAN IVY (*Gynasys cordifolia or Senecio scandens*), a creeping plant of the *Compositæ* family, with fleshy light-green leaves. It is commonly grown as a house plant.

GERMAN LANGUAGE AND LITERATURE. See GERMANY — HISTORY OF LANGUAGE; HISTORY OF LITERATURE.

GERMAN LUTHERANS. See LUTHERAN CHURCH IN AMERICA.

GERMAN MEASLES. This disease is acute, very contagious and of unknown causation. It differs from measles in the mildness of its onset and symptons, in the quicker appearance of the rash after the first signs of illness, and the more rose-red tint of the developed rash. It is distinguished from scarlet fever by its mildness of onset, the patchy character of the rash, without diffuse redness and the shorter duration. The disease develops in

10 or 12 days after exposure, lasts about 3 to 5 days and is followed by a moderate branny desquamation. Complicating bronchitis, pneumonia, gastro-intestinal catarrhs and kidney disturbances may occur, but are infrequent.

GERMAN METHODISTS. See EVANGELICAL ASSOCIATIONS.

GERMAN OCEAN. See NORTH SEA.

GERMAN REFORMED CHURCH. See REFORMED CHURCH IN THE UNITED STATES, GERMAN.

GERMAN SEVENTH-DAY BAPTISTS. See BAPTISTS.

GERMAN SILVER, a white alloy used in many ways as a substitute for silver, consisting of nickel, copper and zinc in various proportions. The best quality consists of four parts copper, two parts nickel and two parts zinc, but this quality is the most difficult to work. For some purposes the proportion of copper is slightly increased, and for articles which are to be cast instead of stamped or hammered about 2 per cent of lead is added. To make a good malleable alloy, the three metals of which it is composed should all be of the best quality. It is harder and tougher than brass and takes a fine polish. In color it is sufficiently near silver to make it valuable for plating with that metal. This, together with its hardness in resisting wear, has caused a great demand for German silver for certain wares made in Birmingham and Sheffield.

Spoons and forks of this alloy are made in immense numbers. Such articles as salvers, dish-covers, jugs, teapots and the like are also largely made of it, but these objects, or at least some of them, are still more largely made of a greatly inferior alloy, because much softer. German silver has a coppery odor and is readily attacked by acid liquids, such as vinegar, which coat it with verdigris. Spoons and forks made of this alloy should therefore either be plated with silver or carefully kept clean. Of late years, through care in preparing a suitable alloy, large objects, such as the bodies of jugs and coffee-pots can be formed of sheet German silver by «spinning» it on the lathe, instead of by stamping or by the slow process of hammering. Formerly it was only a soft alloy that could be so treated. For some time past there has been a tendency to substitute for electroplate — that is, German silver plated with real silver — white alloys having nickel for their basis. These, however, are but varieties of German silver known under different names, such as silveroid, argentoid, navoline and nickeline. Some of them contain small quantities of tin, cadmium and other metals. Mountings for ship-cabins, bar-fixtures, forks and spoons, and other similar articles have been manufactured on a considerable scale from these new alloys. See ELECTROPLATE; METALS.

GERMAN SOUTHWEST AFRICA, the first of the German successful attempts at colonization, situated, as its name implies, on the southwest coast of Africa. To the west of it lies the Atlantic Ocean; to the north, Angola (Portuguese West Africa); to the east and south, British South Africa. The whole territory comprises about 322,000 square miles and has a coast line a little less than 1,000 miles. Almost in the centre of this coast line is the British territory and port of Walfish Bay comprising an area of about 430 square miles. Politically this territory forms a part of Cape Colony.

Topography.— German Southwest Africa is divided naturally into three parts; a long sandy strip about 10 miles wide skirting the Atlantic Coast; an equally barren steppe of about 50 miles wide behind this coastal region; the eastern slope toward the British territory. The central steppe extends into a mountain range from 3,000 to 8,000 feet in height, the higher part of the range being known as the Omatako Mountains. The eastern section merges into the Kalahari desert. Throughout the whole territory there are many rivers and streams; but owing to the prevalence of the southeast trade winds, which blow for the most part overland, they become dry almost altogether for a considerable part of the year, the Orange, Kubango and Cunene alone maintaining currents of water throughout all seasons. It naturally follows, therefore, that the territory is, in general, very dry. There is a short modified rainy season on the uplands, when the streams are filled by intermittent thunder storms. This is the season of the most activity.

Agriculture and Industries.— Most of the activities of German Southwest Africa are given over to stock raising. In the last normal year (1913) before the outbreak of the European War, the stock raised on the colony is given as follows: Sheep, 543,347; goats, 516,904; cattle, 205,643; horses, 15,916; mules and asses, 13,618; karakul, 11,194; swine, 7,772; camels, 709. This estimate of production includes that of the white and native population alike; but as the country is large, exceedingly rough in parts and difficult of communication, it is probable that a very considerable part of the native production went unrecorded, being used as food or exported secretly into Portuguese or British territory.

Though German Southwest Africa possesses promising mining regions; and the valleys of the rivers of the uplands are often capable of producing many European products, little has been done in the way of development. This is due, in part at least, to the small white population which, on the outbreak of the European War was about 15,000, most of whom were Germans, out of a population of about 100,000. The few of these not engaged in stock raising, occupied administrative positions principally in trade and commerce. Less than 30,000 tons of copper were exported in 1913. The previous year 766,465 carats of diamonds were mined in the Lüderitzbucht region.

The commerce of the territory is very small compared with its extent and population. The exports, which consist principally of cattle, hides, ostrich feathers, copper ores, diamonds, skins and guano, range from $6,000,000 to $9,000,000 a year; while the imports amount to about $8,000,000 in normal times. These imports consist principally of food stuffs, textiles, beer, tobacco and iron in various forms. Naturally, before the beginning of the European War, most of the foreign trade through the seaports was with Germany.

Transportation, considering the extent of the territory, is very poorly developed, though perhaps nearly as much so as that of East Africa. One long highway stretches throughout the length of the colony from north to south, connecting the interior with the coast, and also with some interior points. Over 1,300 miles of railway give the colony better railway facilities than either of the other German African territories possess. The Otava Railway is 417 miles in length; the Swakopmund-Windhoek, 237; the Northern, 314; the Southern, 339. Internal telegraph lines connect with the railway telegraph lines and with the Cape and Mossamedes cable by way of Swakopmund. While there are numerous harbors on the Atlantic coast, there are only three of any commercial importance. These are Angra Pequena, Swakopmund and Walfish Bay (British). Of these the second is of most importance forming as it does, the outlet for Swakop Valley and the highlands beyond it. This harbor too, before the outbreak of the European War, was connected by a line of steamers with Hamburg.

History and Government.—A Bremen merchant by the name Lüderitz established at Angra Pequena, a trading station in 1883, and acquired certain rights over surrounding territory. These the German government took over the following year, and extended its holdings gradually northward, southward and into the interior. Portugal and Germany mutually settled the northern boundary between their respective territories in 1886; and four years later Great Britain came to an understanding with the German government as to the eastern and southern boundaries of German Southwest Africa. The domination of the territory went steadily forward. In 1903 a Hottentot tribe, the Bondelzwarts, took up arms in the south against the invaders and carried on war for over a year. They had scarcely been put down when the Hereros in the north rebelled against German authority, massacred the whites everywhere and threatened to wipe them out entirely. The colony was saved by the arrival of reinforcements from Germany. The southern Hottentots joined in the war on the foreigners against whom they held their own for over a year. In this war which lasted into 1906, the Germans lost over 2,000 men out a force of about 15,000. The natives, too, suffered severely, for both sides resorted to the most savage practices. Notwithstanding this, the war broke out again three years later, under the leadership of Morenga, a former leader who had taken refuge in British territory. But this time the Germans were better prepared and Morenga was driven into the mountains and finally killed. From this time on German authority was practically supreme in the colony until after the outbreak of the European War. In August 1914 the British government proposed to the government of South Africa the seizure of the ports of German Southwest Africa and such territory as might be thought advisable. But a serious insurrection in the British colony prevented this step being taken and it was not until the end of this trouble that operations began against the German possession in January 1915; though some preliminary steps had been taken in September 1914, when Lüderitz Bay had been seized. Swakopmund fell in January and two armies were sent against the capital of the territory, Windhoek, one under Botha from the north and the other under Smuts from the south. Botha reached Windhoek on 12 May and the German forces surrendered on the following 9 January. Consult Dove, 'Sudwestafreka' (Berlin 1913); Watermeyer, 'Deutsch-Sudwest Afrike' (Berlin 1899).

GERMAN STOCK EXCHANGES. The German stock exchanges are under government supervision. Prices are officially fixed. In the case of cash transactions, a uniform price for each stock is calculated daily, and all orders carried out accordingly. Quotations for the account vary according to the business done. Industrial securities can only be dealt in for the account, if officially admitted. The principal German Exchange is the Berlin Börse. Prior to 1913, the nominal value of the securities quoted on the Berlin Börse has had an average annual increase of 2½ milliards of marks.

In consequence of a more concentrated industrial activity and less inflation of stock and bond issues, interest is, as a rule, somewhat higher in Germany than in the neighboring western countries, gilt-edged securities and first-class shares producing a better average yield.

Number of officially quoted securities — The Berlin Exchange — (1813), 29; (1848), 85; (1880), 950; (1912), 3,200. Consult 'Germany's Economic Forces' (1913).

GERMAN Y LLORENTE, hĕr'mān e lôr-ĕn'tā, **Bernardo,** Spanish painter: b. Seville, 1685; d. 1757. His artistic training was due to his father and Cristóbal López. His portrait of Don Philip, the Infanta caused Philip V to offer him the position of court painter which he refused because of his desire to remain independent. He was made academician of Saint Ferdinand in 1735. In many countries his works have been sold as original Murillos, because of the resemblance in drawing and grouping, although of course otherwise inferior. He frequently painted the Virgin Mary as a shepherdess and thus earned the soubriquet of «painter of the Shepherdesses.» Fine examples are those in Saint Ildefonso, Madrid, and in the Prado.

GERMANDER, jėr-man'dėr (French, *germandrée*), *Teucrium*, a large and widely distributed genus of labiate herbs, of which all the European species are of old medicinal repute on account of their aromatic bitter and stomachic properties. The species are numerous. The wall germander or true germander (*T. chamædrys*), often found on ruined walls in Great Britain, has probably been introduced from Europe. Wood germander or wood sage (*T. scorodonia*) is a very common British plant, in dry bushy or rocky places. It is very bitter and slightly aromatic. It is used in the Island of Jersey as a substitute for hops. Water germander (*T. scordium*), in wet meadows, has a smell like garlic. Cat or sea thyme (*T. marum*), of southern Europe, like catmint and valerian root, has great attractiveness for cats. It is still sometimes used in the preparation of sneezing powders. The American species (*T. canadense*) is also known as wood sage.

GERMANIA, a country of ancient Europe. See GERMANY.

GERMANIA. Tacitus's 'Germania' was published in 98 A.D. It is a brief treatise on the geography, peoples and institutions of the Germans. The larger portion of the work — and by far the most interesting — is devoted to a consideration of those customs and institutions which are common to the Germans as a whole. Thus Tacitus tells us that the government was democratic. Kings and generals were selected by the people. Their power was limited, not arbitrary. Minor matters were determined by the chiefs, but on more important issues the whole tribe deliberated. The men assembled in arms and listened to speeches by the king or military chief, indicating their dissent by loud murmurs, their approval by rattling their spears. As to-day, war was «the chief industry.» In battle it was considered a disgrace to have survived one's chief and to have returned alive from the field. To defend the chieftain, to protect him, to ascribe one's own brave deeds to his renown, was the height of loyalty. «The chief fights for victory; the followers fight for the chief.» If a tribe sank into a state of prolonged peace, its youth sought service with some chieftain who was at war. Mercury, Hercules and Mars were the chief deities. But there were no graven images. Their gods were rather spiritual abstractions. Augury and divination by means of bits of twigs were much resorted to. In their jurisprudence, penalties were distinguished according to the offense. Traitors and deserters were hanged on trees. Cowards and those guilty of sexual transgression were plunged in bogs and hurdles were then laid over the spot. There were no towns or even clusters of contiguous dwellings. People lived scattered and apart, attracted by the convenience of some spring, meadow or wood. To store the year's harvest, subterranean caves were constructed. Marriage laws were strict, and a lofty conception of the married state prevailed. Monogamy was the rule. Only a few chiefs took more than one wife, and then not from motives of sensual indulgence, but because they were importuned from many quarters to form alliances. Loss of chastity in a woman was unpardonable. For such a one, marriage became an impossibility. To destroy or limit offspring was held to be infamous. A certain sanctity or prophetic instinct was attributed by the Germans to their women. Their counsels and answers were held in the greatest respect. Not long before Tacitus wrote, a certain Veleda was even worshipped as a divinity.

The purpose of the Germania has been differently conceived by different critics. Some have thought that Tacitus' object was, by holding before his countrymen a picture of the Germans, to mark the contrast between the two civilizations, German and Roman, and to commend the rugged simplicity of the one as opposed to the degeneracy of the other. Others have regarded the treatise as a political pamphlet, written in support of Trajan, and intended to justify the attention which that prince was then bestowing upon the problems presented by the tribes of the north. Yet others have thought that the work was prepared as an introduction to the extensive historical writings which Tacitus had already projected. But there are serious objections to each of these views. Moreover it seems less probable that the Germania should have been composed with any «tendency» or purpose beyond the perfectly natural and obvious one of acquainting its readers with accurate details of German geography and institutions. The German people had long been known to the Romans, and for a century and a half had furnished a more or less constant opposition to the Roman arms. Nor was the subject new; Cæsar, Livy, Pliny and others had given detailed accounts of this interesting and important race. That Tacitus, therefore, should have undertaken a fresh presentation of their geography and customs seems perfectly natural, without resort to the theory of a special extraneous motive.

Whatever its original purpose, the Germania must be recognized as a mine of authentic information concerning the ancient Germans. It is not merely this, but is also a source of first importance for all modern study of Germanic institutions in countries outside of Germany itself. The seeds of many vigorous Anglo-Saxon institutions are readily recognizable in the descriptions of Tacitus. Translation by Maurice Hutton, in the Loeb Library.

Charles E. Bennett,
Professor of Latin, Cornell University.

GERMANICUS CÆSAR, Roman general: b. 15 B.C.; d. Epidaphnæ, near Antioch, 9 Oct. 19 A.D. He was the son of Nero Claudius Drusus, and of Antonia, daughter of Mark Antony and niece of Augustus. By desire of Augustus he was adopted in the year 4 A.D. by Tiberius, whom he accompanied in the war against the Pannonians, Dalmatians and Germans. In the year 12 he was consul, and next year was appointed to the command of the eight legions on the Rhine. He was at Lugdunum Batavorum when news came of the death of the Emperor Augustus and of the mutiny for more pay and shorter service among the soldiers in Germany and Illyricum. Germanicus hastened to the camp and quelled the tumult by his personal popularity; and at once led his soldiers against the enemy. Crossing the Rhine below Wesel, he attacked and routed the Marsi, and next year marched to meet the redoubtable Arminius (q.v.), the conqueror of Varus and his legionaries, whose bones had lain unburied for six years in the Teutoburg Forest. With solemn rites his soldiers buried these sad relics of disaster, then advanced against the foe, who, retiring into a difficult country, managed to save himself, and was not subdued till the year after, when Germanicus again carried a part of his army up the Ems in ships, crossed to the Weser and completely overthrew Arminius in two desperate battles. Tiberius, jealous of the glory and popularity of Germanicus, recalled him from Germany in the year 17, and sent him to settle affairs in the East, at the same time appointing as viceroy of Syria, in order secretly to counteract him, the haughty and envious Gnæus Calpurnius Piso. Germanicus died, probably by poison administered at the instigation of Tiberius. His wife, Agrippina, and two of her sons were put to death by order of Tiberius; the third son, Caligula, was spared. Of the three daughters who survived their father, Agrippina was as noted for vice as her mother for virtue. His literary remains were first published at Bologna in 1474.

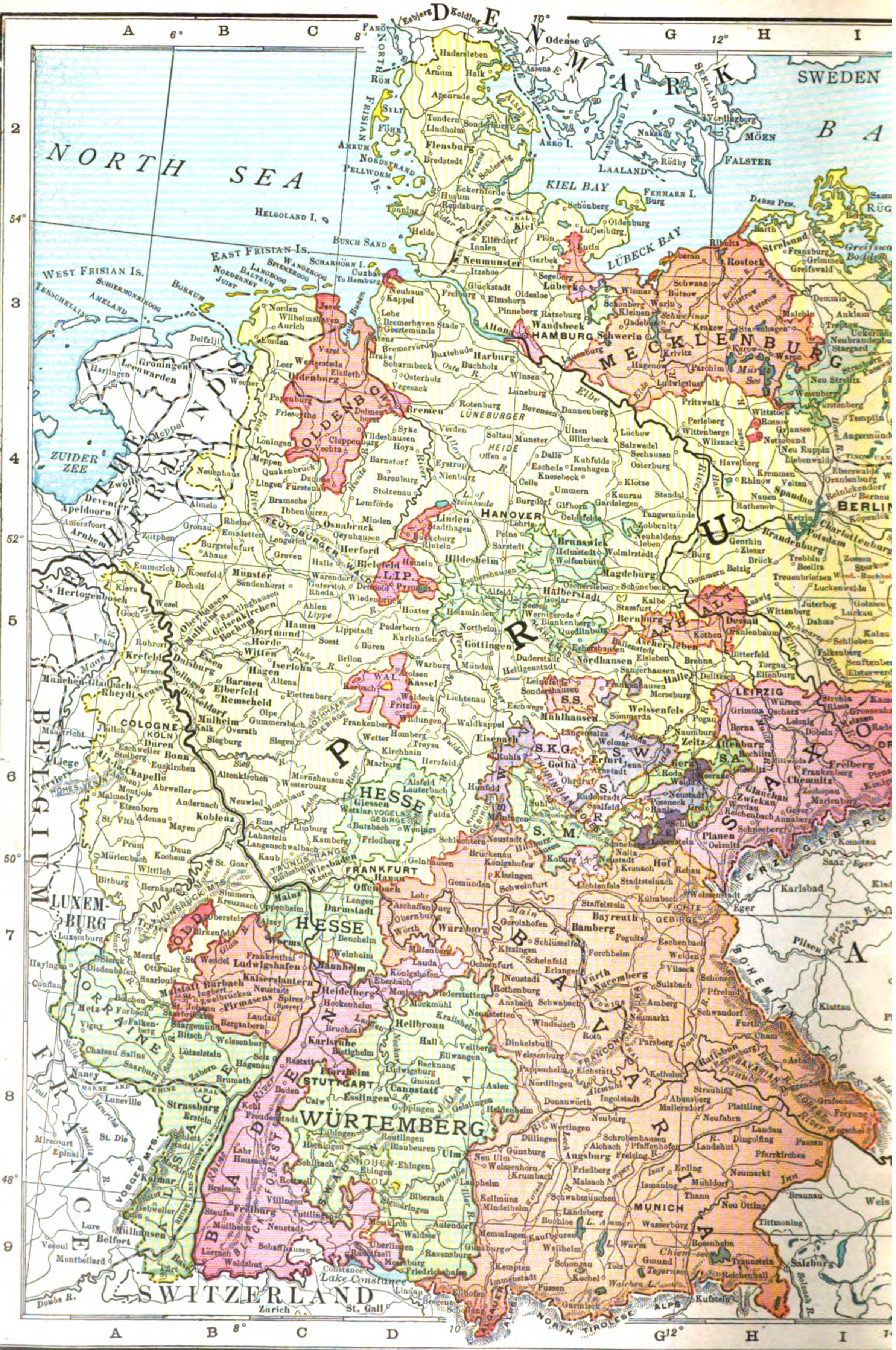
GERMANIUM, a metallic chemical element discovered in 1886 by Dr. Winkler in a silver ore (argyrodite); symbol, Ge.; atomic weight, 72.3. It has a melting-point about 1,650° F. (900° C.); is oxidized when heated in air; crystallizes in octahedra; has a perfectly metallic lustre and is of a grayish-white color. As gallium had been named from France, the new metal was named after Germany. Fifteen years before its discovery its existence was prophesied by Mendeleeff as required to fill the gap in the periodic table between silicon and tin.

GERMANO, SAN, or CASSINO, Italy, town situated at the base of Monte Cassino, in the province of Caserta, about 50 miles north northwest of Naples. It contains handsome public edifices, and is surrounded by the remains of monuments and buildings of high antiquarian interest; it is built on the site and from the ruins of the ancient Volscian town, Casinum or Casca. The principal ruins of the ancient Volscian period are a monument, supposed to have been a tomb, an amphitheatre and a temple. The monument building is now used as a church; it is square, in the form of a Greek cross, constructed with enormous squared blocks of stone, on the Cyclopean principle. From its form, it is called the Church of the Crucifix, or *Crocefisso.* The amphitheatre must have been a magnificent building, and it is still in a state of preservation sufficient to give an idea of its original vast proportions. The temple, adjoining the amphitheatre, was built probably in conjunction with it, at the cost of the Volscian matron, Umidia Quadratilla, mentioned by Pliny. The Benedictine monastery of Monte Cassino, two miles from San Germano, is one of the most renowned religious communities of Europe. Its foundation by Saint Benedict dates from 529. It contains one of the most beautiful churches of Italy, and an extensive library, and in its archives a collection of the most precious documents of the Middle Ages. The district surrounding San Germano is highly cultivated and beautiful. The town was admitted to Roman citizenship about 188 B.C. We find occasional mention of it (as Casinum) in the narratives of the Hannibalic War. Varro built a villa in the neighborhood, in which at a later period were held orgies by Mark Antony. The town become a *præfectura* toward the close of the republican period and under the empire it is named a colony, although two inscriptions refer to it as a *municipium.* It is mentioned both by Strabo and Varro. The hill near the monastery has an elevation of 1,715 feet above sea-level, and there still exist traces of the ancient fortifications in Cyclopean masonry. Numerous Roman inscriptions from the ancient Casinum are preserved in the monastery. On the opposite bank of the rapids lies a group of ruins called Monticelli, and by many considered the remains of Varro's villa. Much of the stone was drawn away by architects and builders in the 16th century.

On 16 March 1815 the town was the scene of an Austrian victory over Murat. Pop. 14,220. Consult Ashby, T., 'Papers of the British School at Rome' (Vol. II, p. 19).

GERMANTOWN, Pa., formerly a suburb of Philadelphia; now the 22d ward of that city, within the municipal limits of which it has been included since 1854. It was settled by Germans, under a grant from William Penn, in October 1683. The town became famous as the scene of one of the really significant events of the Revolutionary War. Here, on 4 Oct. 1777, a battle took place between the armies under Washington and the English under Howe. See GERMANTOWN, BATTLE OF; and PHILADELPHIA.

GERMANTOWN, Battle of, 4 Oct. 1777. Howe having captured Philadelphia, stationed his army across the Germantown road north of the city and east of the Schuylkill; the left wing with its supports on the river, the right "in the air" to the east. He shortly detached part of it to reduce the forts which blocked the Delaware below the city; and Washington planned the capture of the weakened army, starting after dark on the evening of 3 October. His right under Sullivan and accompanied by himself, with six brigades, was to move down the main street and crush the British left; the Pennsylvania militia to march along the river and take it in flank; the left under Greene was to divide, three brigades under himself taking the British right in front and flank, while two others were to move to the east and come up in its rear. This would drive it back upon the left and both on the river, and it was hoped would compel surrender. A mile or so north of the British centre on Mount Airy were a battalion of light infantry and a battery; in a field just left was a regiment under Colonel Musgrave; a little south on the main road was the massive stone house of former Chief Justice Chew. At sunrise a heavy fog came up and left all darker than ever. The British advance bodies were overwhelmed by the Americans, and the battery captured; but Musgrave took shelter in Chew's house, and after an unsuccessful attempt at breaching it with the light guns, the Americans left a brigade to besiege it and pushed on. Despite this delay and the warning to the British, both their wings soon began to give way before the American onset. But in the fog, the heavy firing at Chew's house drew General Stephen with his brigade, on Greene's right, too far west, thinking the main fight was there; and Wayne on Sullivan's left had turned considerably east and came in front of Stephen, who took him for the enemy and attacked him in the rear. Wayne's men were driven against the next left of Sullivan's remaining brigades, a panic started and a general retreat began. The British took the offensive, and reinforced by Cornwallis from Philadelphia, pressed the Americans hard; but the latter soon regained composure and retired in good order, though one regiment of Greene's was surrounded and captured. The Americans, however, brought away several captured cannon, and all their own and their wounded. Their loss in killed and wounded was 673, the British 535. Stephen was accused of having drunk too much on the night march, court-martialed and dismissed from the army. Despite the failure of the plan, the ultimate results were very great. The audacity of the Americans in attacking the British so soon after the defeat of the Brandywine, together with Gates's success at Saratoga, were large factors in determining the French alliance. Consult Carrington, 'Battery of the American Revolution' (New York 1878); Lossing, 'Field Book of the Revolution' (ib. 1859); Jenkins, 'Washington in Germantown' (ib. 1905).



DENMARK
SWEDEN
NORTH SEA
HELGOLAND I.
EAST FRISIAN IS.
WEST FRISIAN IS.
NORTH FRISIAN IS.
KIEL BAY
LÜBECK BAY
FEHMARN I.
LAALAND
FALSTER
MÖEN
SEELAND
FYEN
SYLT
FÖHR
AMRUM
ZUIDER ZEE
NETHERLANDS
BELGIUM
LUXEMBURG
FRANCE
SWITZERLAND
Lake Constance
PRUSSIA
MECKLENBURG
OLDENBURG
HANOVER
HAMBURG
BERLIN
LEIPZIG
HESSE
WÜRTEMBERG
BAVARIA
BADEN
SAXONY
ALSACE
LORRAINE
ANHALT
BRUNSWICK
FRANKFURT
COLOGNE
MUNICH
STUTTGART
Bremen
Kiel
Lübeck
Magdeburg
Kassel
Mainz
Nuremberg
Strassburg
Karlsruhe
Heidelberg
Mannheim
Würzburg
Augsburg
Ulm
Freiburg
Metz
Koblenz
Bonn
Düsseldorf
Elberfeld
Barmen
Dortmund
Münster
Osnabrück
Hildesheim
Göttingen
Halle
Weissenfels
Erfurt
Gotha
Weimar
Jena
Plauen
Zwickau
Chemnitz
Freiberg
Hof
Bayreuth
Bamberg
Regensburg
Ingolstadt
Passau
Landshut
Salzburg
Karlsbad
Pilsen
Eger
Zürich
St. Gall
Belfort
Mülhausen
Nancy
Danube
Rhine
Elbe
Weser
Main
BLACK FOREST
VOSGES MTS.
TEUTOBURGER WALD
ERZ GEBIRGE
BOHEMIAN FOREST
BAVARIAN FOREST
ALPS
A
B
C
D
G
H
I
2
3
4
5
6
7
8
9
6°
8°
10°
12°
54°
52°
50°
48°


Longitude East from Greenwich
N. E. EXTENSION
States of the German Empire.
KINGDOMS:
1 Prussia
2 Bavaria
3 Saxony
4 Würtemberg
GRAND DUCHIES:
5 Baden
6 Hesse
7 Mecklenburg-Schwerin
8 Saxe-Weimar
9 Mecklenburg-Strelitz
10 Oldenburg
DUCHIES:
11 Brunswick
12 Saxe-Meiningen
13 Saxe-Altenburg
14 Saxe-Koburg Gotha
15 Anhalt
PRINCIPALITIES:
16 Schwarzburg-Rudolstadt
17 Schwarzburg-Sondershausen
18 Waldeck
19 Reuss, elder line
20 Reuss, younger line
21 Schaumburg-Lippe
22 Lippe
FREE TOWNS:
23 Lübeck
24 Bremen
25 Hamburg
IMPERIAL TERRITORY:
26 Alsace-Lorraine
BERLIN AND ENVIRONS.
SCALES.
Statute Miles, 4.3 = 1 Inch.
Kilometres, 7 = 1 Inch.
GERMAN EMPIRE
SCALES
Statute Miles, 63 = 1 Inch.
Kilometres, 101 = 1 Inch.
Rand, McNally & Co.'s, New 11 x 14 Map of German Empire.
Copyright by Rand McNally & Co.
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GERMANY, or THE GERMAN EMPIRE. In the following series of articles will be found the history and development of German civilization in every sphere of activity up to the beginning of the Great World War in 1914. The war history will be found fully described in Volume 29 under the title WAR, EUROPEAN, OR GREAT WORLD WAR. In view of the events, 1914–18, these articles will be found worthy of careful study by all students of history, government, national ideals, and of the rise and fall of nations. The series comprise the following articles:

1. PHYSIOGRAPHY. Germany, or the German Empire (Deutsches Reich, emperor Deutscher Kaiser, 208,830 square miles), the third in size of the European states and the most central of the powers of Europe, covers the territory between the Alps and the North and Baltic seas, between 56° and 47½° N. and 6° and 23° E. It is bounded, east by Russia, southeast and south by Austria and Switzerland, west by France, Luxemburg, Belgium and the Netherlands, north by Denmark.

Physiographically, the German territory consists of three main divisions: The Alpine region, the «Mittelgebirge» (Central Ranges), and the North German Lowland.

The highest elevations are in the south, where the Northern Limestone Alps enter on Bavarian territory (Zugspitz, 9,660 feet). At their base a plateau covered with glacial drift, about 2,000 feet high, interspersed with many lakes (Bodensee, Stranberger, Chinemsee) stretches north as far as the Danube, drained by the tributaries of this river which bounds it along a large fault line.

The Mittelgebirge is an old mountainous country of Appalachian type, whose ranges are controlled by two directions of tectonic movements: The Rhenish, running southwest-northeast, and the Hercynian System, running southeast-northwest. To the former belong (see map), beginning in the south: The Swabian Jura, Erzgebirge, Black Forest-Odenwald-Spessart, Taunus, Westerwald on the right, and Vogesen-Hardt, Hunsrück and Eifel, left of the Rhine; to the latter: The Bohemian Forest, Thuringian Forest, Teutoburger Forest, the Weser Mountains and Sudeten; the horseshoe-shape of the Fichtelgebirge and the parallelogram of the Harz present a combination of the two. Intersecting each other in many places, these ranges produce a chessboard-like dissection of the country which has not been without influence on the political dissection of central Germany into many small states.

The north is a large lowland, narrow at the west and widening toward the east where it joins the great Russian lowland. It is dissected by two heights of land extending, respectively, from Silesia along the middle course of the Elbe and across that river between the lower courses of Elbe and Weser to the North Sea, and from eastern Prussia along the Baltic Coast into Slesvig-Holstein. The latter culminates near Dantzig in the Turmberg (1,000 feet) and is dotted with innumerable lakes («Seenplatten» of Prussia, Pomerania and Mecklenburg); the former consists mostly of glacial sands (Fläming, Lüneburger Heide) and is of little interest economically or scenically.

Rivers.— The courses of the rivers are adjusted to these topographic conditions flowing partly in one, partly in the other, direction. Thus the Rhine flows first north-northeast, then west-southwest, then northwest. The Danube first northeast and then southeast; the rivers of the lowland; Weser, Elbe, Oder, alternate between a more westerly or northwesterly direction where they follow the general slope of the Hercynian system predominating in the east and a northerly course where they cut through the heights of land. The Main is perhaps the best illustration of the complicated topography of central western Germany; Neckar, Moselle and Lahn dissect, the former, the terraced country east of the Black Forest; the latter two, the old peneplain through which the lower Rhine has cut its gorge. The largest tributaries of the lowland rivers on the right repeat the zigzag of the main watercourses so exactly that they almost establish connections between the corresponding reaches of the latter: Weser-Aller-Elbe, Elbe-Havel-Spree-Oder, Oder-Warthe-Netze-Vistula. An extensive canal system utilizes these conditions for commercial purposes, thus reconstructing the watercourses of the glacial period when at different stages of the advance and retreat of the ice sheet the waters collected at its southern margin and flowed westward or northwestward along it to join the ocean in the present lower courses of the Weser and Elbe. The tributaries on the left generally continue the south-north reaches of the main rivers, and during the eastward expansion of the nation often gained strategic importance, such as the Saale-Elbe line in the struggles with the Slavs. The Vistula belongs to Germany only in its lower course; east of it the Pregel and Memel are coastal rivers of great commercial importance; so is the Ems in the extreme northwest; the Eider in Slesvig, by means of a small canal, once connected the Baltic with the North Sea until it was superseded by the large Kaiser Wilhelm Canal. Of the large rivers the Rhine is the only one which, owing to its Alpine origin, affords good shipping all the year round. The others generally suffer from lack of water during the dry season, and only by extensive river regulation has it been possible to satisfy the needs of modern river transportation.

Harbors.— The seaports suffer from similar disadvantages. The Baltic has good river harbors (Königsberg, Dantzig, Stettin) or fiords (Kiel), but their location on an inland sea, though recently improved through the Kaiser Wilhelm Canal, puts them at disadvantage. Those on the open North Sea have to combat with the dangers of shallow water on a sinking coast («Watten»), and Hamburg and Bremen owe their importance more to the energy of their merchants than to natural advantages. Wilhelmshafen, the naval port on the Jade Bay, is an entirely artificial creation. The chain of the Frisian Islands represents the old coastline, Heligoland being the only genuine island in that region. On the Baltic Coast, Rügen is the largest and most picturesque of the German islands.

Climate.— Being open to the mild westerly winds, Germany has a milder climate than would be expected from its latitude. There is little difference between the north and south, as in the latter higher elevation counterbalances the southerly location. The mean annual of Hamburg is 48° F., of Leipzig, 47°. of Munich, 45°. A greater contrast exists between the east and west, the lowland sharing already the continental climate of Russia with colder winters and warmer summers. The latter allow the vine to reach here its most northerly location on the earth, at Grüneberg on the Oder, in lat. 52° N. The valley of the upper Rhine is the only part of Germany where low elevation and low latitude are combined; here we find, therefore, the warmest parts of the empire, where Indian corn is cultivated and chestnut forests abound.

States.— Politically, the German Empire is a union of 26 states under the leadership of an emperor. Twenty-two are monarchies: four kingdoms (Prussia, Bavaria, Saxony, Württemberg), six grand-duchies (Baden, Hesse-Darmstadt, Oldenburg, Saxe-Weimer-Eisenach, Mecklenburg-Schwerin, Mecklenburg-Strelitz), five duchies (Anhalt, Saxe-Altenburg, Saxe-Meiningen, Saxe-Coburg-Gotha, Brunswick), seven principalities (Waldeck, two Schwartzburg, two Lippe, two Reuss), each under its own king, grand-duke, duke or prince, and with an upper and lower house (except Mecklenburg which has not yet a constitution); besides these there are three republics: Hamburg, Bremen and Lübeck, the old Hansa towns with their territories, and one «Reichsland» (imperial territory): Alsace-Lorraine, regained from France in 1871, and, for lack of a hereditary prince, placed directly under the imperial government, with a governor appointed by the emperor. Prussia alone occupies about two-thirds of the whole empire, practically all of northern Germany, with exception of a few of the smaller states interspersed between her provinces. Since 1871 the king of Prussia holds the office of German Emperor, made hereditary in the Hohenzollern dynasty, and Berlin thus is the seat of both the Prussian and the federal government. The latter consists of the emperor and two houses, similar to the state governments, but the members of the lower house are elected by direct and secret vote, while the modes of the state elections are quite intricate. The upper houses of the states and the empire consist of representatives of the governments.

Population.— Exclusive of Berlin, Germany had, in 1915, 40 cities with over 100,000 inhabitants, mostly industrial centres and state capitals. The majority of the population (60,000,000) are of Germanic origin, especially in the older countries west of the Saale-Elbe line. East of this line lives a more colonial race, with a large admixture of slavic blood. Among and beyond them there are 3,000,000 Poles in the formerly Polish provinces of Prussia: in the east 140,000 Masurians, 106,000 Lithuanians, 100,000 Cassubians; on the upper Spree 90,000 Wends; 220,000 French in Alsace-Lorraine; 11,000 Walloons along the Belgian, and 140,000 Danes near the Danish line. Although no more than one-tenth of the whole population, these foreign elements are not insignificant, because most of them have their mother country back of them, and the problem is still more complicated by the overlapping of the German race into foreign territory on the northeast, southeast and south.

Geology.— The oldest parts of Germany, geologically, are the metamorphic rocks of the Bohemian Forest-Erzgebirge-Sudeten region, the Thuringian and Black Forests, the Vosges, etc. Of paleozoic rocks, Algonkian and Cambrian schists and quartzites occur in the southwest, Erzgebirge (Vogtland), the southeast, Thuringian Forest (Frankenwald), and Eichtelgebirge. Silurian schists, limestones, and sandstones occur above them in these three ranges and the eastern Sudeten, while the Rhenish Slate Mountains (Eifel) are the classical locality of the German Devonian, and the Harz includes portions of all paleozoic formations. Igneous rocks (diabases) and mineral veins intersect them.

Between the lower and upper Carboniferous this whole area of paleozoic rocks was folded into a mountain system of Alpine height, extending from Belgium to the Sudeten («Variscian Mountains» of Suess, or Paleozoic Alps). Eruptions of volcanic matter accompanied the mountain making forming the granite massifs of the Erzgebirge, Black Forest, etc. In the valleys between the ranges and in the low country at their base the deposition of the carboniferous formation took place. The German Carboniferous belongs to the terrestrial facies of the period, the lower part (Culm) being shales and sandstones of litoral origin with occasional coal seams (Hainichen, Saxony); the upper includes the productive coal fields. They extend with little interruption from Belgium along the northern slope of the Rhenish Devonian into Westphalia (Ruhr Basin), and with the fields around Saarbrücken farther south, in Saxony (Zwickau), and Silesia (Waldenburg, Myslowitz), are the most important sources of coal supply in central Europe.

The Permain consists of two epochs: Rotliegendes and Zechstein. During the Rotliegende the area remained land, the Paleozoic Alps were worn down to Mittelgebirge heights, and their deposits filled the depression with sands and conglomerates of a reddish color; hence the name. Occasionally coal beds occur between them. Volcanic activity continued in some places (porphyrites and pitchstones of Saxony). In the Zechstein epoch the ocean advanced again, leaving its deposits on the northern edge of the Mittelgebirge, especially around the Harz and in northern Thuringia. Among them are the famous copper-bearing shales of Mansfeld, the Zechstein proper (shallow water limestone), and the immense salt beds of the upper Zechstein epoch (Stassfurt, Sperenberg) with their large supplies of gypsum and «araum» salts.

The Triassic period consisted of three epochs in Germany. In the first a shallow sea covered especially western Germany, forming the reddish sandstones (Buntsandstein) which cover miles and miles from Basel to Osnabrück, the western slope of the Eifel, the region around Tarnowitz in Silesia, and form the cliffs of Heligoland. This sea deepened in the second epoch producing a shell limestone (Muschelkalk), but in the third (Keuper, pron. coiper) was cut off from the main ocean and formed gay colored marls and sandstones with occasional coal seams. (Lettenkohle). The uppermost stage of the Keuper, the Rhaetic, shows the beginning of another transgression of the ocean, that of the Jurassic period.

About the Alpine facies of the Triassic, see ALPS.

The Jurassic ocean overflooded all of central Europe, with only the tops of the mountains standing out as isles. It reached a great deal higher up on their sides than its present distribution would indicate, since the highest deposits were probably eroded in subsequent periods. At present we find its deposits in South Germany on both slopes of the Black Forest and Vosges, and especially in the range of the Swabian-Franconian Jura, where the lithographic stones of Solnhofen belong to its upper epoch. It also occurs in the north foothills of the Mittelgebirge, near the Elbe in Saxony, in Silesia, and evidently underlies the whole lowland, cropping out frequently from under the younger deposits.

Likewise a zone of Cretaceous hills skirts the northern border of the Jurassic ranges, with many isolated occurrences in the lowland. The second part of the Cretaceous again witnessed a large advance of the ocean, its deposits often lying on rocks several periods older in places which had never been submerged since; on archaic and paleozoic rocks in Saxony, on Carboniferious in Westphalia, etc. The white chalk cliffs of Rügen and the Pläner sandstone of Saxon, Switzerland, are the best known examples of German Cretaceous.

The Tertiary was again a period of great geological disturbances: Mountain folding, volcanic eruptions and changes of shore-lines. During the Eocene, almost all Germany was land; but in the Oligocene a shallow sea extended over the lowland as far as Bonn, Leipzig and Silesia. Local oscillations favored the formation of coal beds, to which soft coal measures (Halle and Leipzig) owe their origin. From the south the sea entered the rift valley formed by the breaking in two of the Black Forest-Vosges massif, the present Upper Rhine Valley. Toward the end of the Miocene, the folding of the Alps began and gradually shut off this bay from the ocean; it became brackish and finally a freshwater lake drained by the later Rhine (Mainzer Becken). All through the Mittelgebirge region volcanic eruptions accompanied these tectonic processes; the volcanoes and volcanic rocks of the Eifel, Siebengebirge, Westerwald, Vogelsgebirge, Meissner, Rhön, northern Bohemia and the eastern Sudeten, together with the hot springs which have created a belt of famous watering places along this line (Ems, Schwalbach, Wiesbaden, Nauheim, Kissingen, Franzensbad, Karlsbad, Marienbad, etc.), in the south the Kaiserstuhl, the Hegan volcanoes (Hohentwiel) and those of the Suabian Jura date from this period. During the Pliocene practically the whole of Germany was land again and ready for the invasion of the Pleistocene ice sheet.

In the Pleistocene six glacial and five interglacial stages have been distinguished of which, however, only the second (the Kansan of America) and third (corresponding to the Wisconsin) deserve special mention. At the time of its largest extension the Scandinavian glacier reached the northern foot of the Mittelgebirge from the lower Rhine southeastward into Silesia. The terminal moraines are well developed along this line and the whole lowland is covered with till and strewn with erratic boulders. Another inland glacier stretched northward from the Alps, covering the Bavarian plateau with its moraine material. The Black and Bohemian Forests and the Sudeten (Riesengebirge) had local glaciers of smaller size.

Palæontology.— The geological description indicates the old faunas and floras. Special mention deserve:

Devonian: Eifel limestones: Brachiopods, crinoids, corals.

The Rotliegende of Chemnitz: cycads, conifers, especially treeferns; of the Saar valley and the Plauen Grund (Dresden): Stegocephales (larvæ and adults).

Zechstein shales of Mansfeld: Ganoid fishes.

Buntsandstein rocks have few fossils but contain footprints of various animals (Thuringia, Franconia).

Muschelkalk limestone (Thuringia, Württemberg) are packed full with fossils, few species, many specimens: molluscs, besides brachiopods, ammonites, crinoids. Terebratula vulgaris is very common, the stalks of Encrinus form whole beds. Ceratites nodosus, practically confined to Germany, is common everywhere.

Keuper sandstones of Württemberg: well-preserved amphibia and reptilia; gigantic Mastodonsaurus, Capitosaurus; huge Belodon, Zanclodon. Famous is a slab with 24 specimens of Aëtosaurus (Stuttgart Museum).

The Jurassic rocks, especially of Swabia and Franconia, show a marvelous wealth of beautifully preserved fossils of all kinds; sponges, corals, jelly-fish, sea-urchins, crinoids, brachiopods, molluscs (ammonites and belenmites especially), crustaceans, insects, many fishes (ganoids especially), and above all the reptiles: Ichthyosaurus, Plesiosaurus, Teleosaurus, the Pterosaures, the unique Campsognathus, finally the two specimens of Archæopteryx so far known. Holzmaden (Württemberg), Solnhofen and Eichstätt (Bavaria) are the famous localities. The finds fill the collections of Banz, Stuttgart, Munich, Berlin. Tübingen has a slab (15 × 24 feet) with 24 Pentacrinies (some measure three feet across).

The flora of the Wealden formation (northwestern Germany) looks like jurassic.

Suddenly the dicotyledons appear in the upper Cretaceous beds.

The Tertiary climate was warm, the flora had a tropical or subtropical character. During the Oligocæne epoch corals could grow. The dense forests and swamps resembled those of Florida and Louisiana of to-day, although plants of a former more Indo-Australian flora survived: Conifers (sequoias, cypresses), evergreen oaks, gardenias, fig trees, cinnamon trees, palms, magnolias, laurels, but also poplars, alders. Several oscillations during the Oligocæne and Miocæne favored the formation of extensive soft coal measures. The amber (East Prussia), the fossil resin of pines and especially one spruce (*Picea Engleri*) contains a rich insect fauna related to those of North America and East Asia of to-day.

The Miocæne flora much resembled the modern North American and Japanese floras: sequoias, bamboo, palms, laurels, camphor and cinnamon trees, fig trees, evergreen oaks, chestnuts, magnolias, myrtles, acacias, mimosas; but also poplars, maples, elms, walnuts, hazel nuts, willows, birches. The fauna likewise shows many specimens found now only in warm countries: elephants, Mastodon, Dinotherium, Rhinoceros, Hippopotamus, tapirs, antelopes, monkeys, together with wild boars, deer, large and small carnivores, and the ancestral forms of the horse.

In the Pliocæne epoch the climate became temperate, animals and plants resembled those of modern North America.

The ice masses of the Pleistocæne advanced and many animals and plants were exterminated, some, however, adapted themselves. The narrow belt finally left between the northern and southern ice sheets had an arctic fauna and flora that had come in from the north. The glacial and interglacial periods caused plants and animals to migrate back and forth. Survivors of the Tertiary were: Hippopotamus, hairy elephants, the mammoth, hairy rhinoceroses; arctic forms: the musk-ox, reindeer, lemming; others: horses, deer, fallow deer, elks, the aurochs, the urus, wild boars, bears, tigers, hyenas. The ice retreated, a wide plateauland or rolling country was exposed. Animals and plants found to-day in the steppe of southeastern Russia and southwestern Siberia came in and mixed with the others: jerboas, bobacs, marmots, altaic gophers, voles, calling-hares, ermines, the Saiga antelope, wild horses, bustards.

Many arctic animals and plants could not stand the change and followed the retreating ice northward or climbed the mountains. Thus the fauna and flora of the Alps and many lower mountains (Schneekoppe, Brocken) contain arctic specimens.

Soon a denser covering with vegetation developed, immigrations from all sides occurred, a new fauna and flora resulted. Lack of connection with a region where the old Tertiary forms had survived prevented restocking. Thus we find fewer species and less variety than in North America or East Asia, and only the Tertiary forms of the three countries are much alike.

Old Germania was moist and cool, had extensive swamps and perhaps 75 per cent of her area covered with dense forests.

Flora.— The flora is that common to northern Europe. Germany lies entirely within the northern forest zone of phytogeography and is pre-eminently a wooded country. Even to-day forests abound (26 per cent of the area; France, 16 per cent; Great Britain, 3 per cent). Man has taken care of the woods, dried out or drained swamps, regulated rivers, planted fields, and thus caused great changes. Little «primeval forest» is left. (North and northeast, Bohemian Forest.)

The flora comprises about 2,200 phanerogames, 60 vascular crytogames; 6 coniferous forest trees: fir, spruce, pine, larch, juniper, yew, 40 deciduous forest trees, 20 shrubs.

An alpine flora (one-third of the alpine plants) is found in the Bavarian Alps and spreads along the rivers onto the high plateau. The Sudeten Mountains (with some arctic forms missing in the Alps) and the tops of other high mountains (Brocken) are isolated centres of alpine plants.

The southern mountainous region (so-called Hercynic flora) is characterized by the fir (Abies alba) and shows a varied flora, the valleys having the Baltic, the mountain slopes a subalpine character. Vine culture is possible only here.

The Baltic flora occupies the northern lowland.

The forest line on the mountain slopes is at about 4,000 feet (Brocken, 3,400; Vosges, 4,264). Above is a zone of trailing trees and shrubs up to about 4,500 feet: Mountain pine (*Pinus montana*), dwarfed willows and junipers, rhododendron (in the Alps); above this the true alpine region with its peculiar flora. The highest peaks have only cryptogames (lichens, mosses). The alpine region in Bavaria begins at 5,500 feet, spruces go up to 5,900, larch trees to 6,200. Generally, heights above 3,500 feet are unfavorable to tree growth and covered with grasses and often heather. In the Alps the region above timber-line is pasture with many flowers (gentians). Many species which are missing in the arctics probably represent alpine plants of the Tertiary (Edelweiss).

The deciduous forests are diminished by secular changes (natural rotation?): the spruce (*Picea excelsa*) is everywhere gaining ground at the expense of the red beech which, as is almost certain, once crowded out oaks, pines, and birches (known to have happened in Denmark). In West Prussia pines replace oaks and birches.

To-day, deciduous forests occupy only the lower mountain slopes, above are coniferous forests. The Spessart only has retained its old oak and beech forest to the top. The large Buntsandstein area in southwestern Germany not good for agriculture supports magnificent forests.

The pine is typical for the northern lowlands and forms forests even on the sand plains. The spruce has spread from the south all over the country. The larch forms groves in the Alps but is not confined to them. The Swiss Stonepine (*Pinus cembra*) occurs in a few places in the Bavarian Alps. The yew once common has almost disappeared and is found only in East and West Prussia, and occasionally in the mountains. The juniper is a tall tree in the East, smaller and rarer in the West, missing in East Friesland; a shrub in the mountains and in the heath.

Deciduous forests are usually mixed, beech forests, however, common. The northern limit for the beech is south of Königsberg. In the north the oak is most characteristic (two kinds); it is the national tree celebrated by songs, poems and myths. Maples, elms, hornbeams, birches, ashes, mountain-ashes, poplars, aspens, wild apples and pears, hawthorns, service trees form the mixed forests which contain no trees with showy flowers, except wild fruit trees, have little underbrush and no climbing vines, except hop, clematis, and ivy. The autumn coloration is not remarkable. The beauty of the mountain forests lies in the mixture of light deciduous and dark coniferous woods, interspersed here and there with meadows or heath patches.

The linden marks former Slavic regions. The chestnut (Mediterranean flora) thrives along the Rhine. The evergreen holly (Mediterranean) is confined to Western Germany. The evergreen box avoids the cold east.

Introduced trees: American horsechestnuts quite common, especially in the cities; American locust trees belong to the flora now and form woods in Anhalt; Oriental cherries, plums, prunes, apricots; and walnut trees are common fruit trees. Along the highways tall Lombardy poplars are seen, but also apple, cherry and plum trees.

Meadows occupy marshy districts along the shores, and together with woods, the flood plains of rivers, and form patches in the mountains and in the Alps. They are a dense growth of grasses (20–30 species) intermingled with a great variety of flowering herbs (meadow saffrons in the fall); natural or cultivated, always indicating moist soil.

On sandy soil birches and pines may grow or the heath develops (heather and vaccinium) (Northwest Germany, tops of mountains, high plateaus of South Germany).

Bogs and swamps cover large areas of the lowland and of the southern plateaus. They are the coldest parts of the country and retain arctic plants. Rushes, sedges, reeds, sphagnum mosses and the insectivorous sundew, Utricularia, and Pinguicula form their flora.

Along the shores a salt flora develops with fleshy leaves and stalks. It is occasionally found inland (near Halle).

Sand dunes have special grasses and thistles.

Elodea canadensis introduced in female plants only has multiplied so that it often blocks navigation in rivers and canals.

Red poppies, blue bachelors' buttons, and purple corncockles adorn the grain fields. Many plants, especially weeds, are spread by man, railways and modern traffic, and foreign plants are mixed in with the native flora.

Difference in climate: fruit trees bloom in Memel about four weeks later than on the Rhine.

Fauna.— Old Germania had a rich woodland fauna. Directly and indirectly man has caused many changes. Many animals were exterminated, others were too much disturbed in their habits and disappeared. The creation by farming of an artificial steppe («Kultursteppe») invited others. Some were protected, other useful or injurious ones introduced.

Mammals.— The urus became extinct probably in the 17th century. The last bison (aurochs) was killed in East Prussia in 1755. The elk is now confined to a few preserves in East Prussia. Wild boars much reduced in number survive only by protection. Bears have not been seen since 1835 (Bavaria). The wolf is now only found along the western mountainous border and in the large eastern forests. The lynx, common in the 17th century, seems to have disappeared (last ones: Harz Mountains, 1818; East Prussia, 1861; Wollin, 1875). Wild cats are scarce. The beaver has narrowed down its habitat to a few quiet places (Elbe near Dessau). The black rat (*Mus rattus*) which spread during the 12th century (from Asia?) is crowded out by the brown rat (*Mus decumanus*) which migrated in from Asia in the 17th century.

The snowhare in the Alps is an arctic relic. The hare, the most popular game, has many enemies, but is still common (game laws). Rabbits have been introduced and occasionally run wild. They are bred here and there, but are not popular.

Red deer are the pride of the woods, the ambition of the huntsmen, the subject of songs and poems. They and the smaller roe deer give the best venison (game laws). The fallow deer, introduced in the 16th century, is usually kept in game parks.

Other mammals are: fox, two martens, fitchet, ermine, weasel, otter, badger, a mink called «Nörz» (*Putorius lutreolus*, very rare in Northeast Germany, reaching here its western limit of distribution); the insectivores: hedgehog, mole, six shrews; the souslik (western limit in Silesia), the hamster (a steppe form which is comfortable in the fields).

The mammalian fauna comprises about 65 species, 16 per cent of the mammals of the paræarctic region.

The *avifauna* has about 225 species. The many singing birds and water-birds are characteristic. Among the former are: finches, bullfinches, skylarks, nightingales thrushes, orioles; among the latter: rails, coots, cranes, herons, bitterns, storks, the spoonbill, swans, geese, brants, many ducks, mergansers, pelicans (very rare), cormorants, many gulls, sternas, greebes and loons, auks, murres. Flamingoes (Mediterranean) have been met with on the Rhine.

The cuckoo (nesting parasitism like the American cowbird) is the only member of a family of about 200 mostly tropical species.

The lammergeier, the largest bird-of-prey of the Old World, seems now exterminated in the German Alps. Three of the Mediterranean vultures occur rarely. The golden eagle has become very scarce, the imperial eagle sometimes penetrates to Germany. The osprey is common, the sea-eagle is found. Gledes, sparrowhawks, hawks, kites, buzzards, falcons are the birds-of-prey. The capercailzie and the heath grouse are interesting (game laws). The large bustard, a steppe animal, is found especially in Saxony.

Many birds of passage breed in Germany and leave in the fall; northern birds spend the winter and go north in spring. From the East birds of the Pontic fauna often penetrate into Germany, sometimes repeatedly until they establish themselves as new members of the fauna. Pallas' sandgrouse (*Syrrhaptes paradoxus*) has several times arrived in large flocks. The large bustard, some larks, quail and partridges, the house-sparrow seem to have come in that way, and like the «Kultursteppe.» The small bustard, the bee-eater (*Merops*), still breed in Southern and Eastern Europe but penetrate occasionally to Germany. They may be about to immigrate. The southwestern gate into the Rhine valley is often used by Mediterranean birds.

In autumn most of the migrating birds fly to the Rhine valley and then south to the Rhône. On Heligoland where many migrating birds take a little rest 396 different species have been observed. The black guillemot breeds here.

Thirteen *Reptiles* belong to the fauna. One tortoise occurs in ponds east of the Elbe. Three lizards (including the blindworm), the ringed snake, and the poisonous adder are common, the smooth snake is common in certain regions. Other lizards and snakes reach the southwest so that here all twelve of them occur; among them is the venomous asp (Metz) and the deadly ammodyte viper.

The *Amphibia* have twelve batrachians and six urodeles. The nurse-frog and the Swiss newt reach into the Rhine valley, the black salamander is alpine.

A great variety of freshwater *fishes* (64 species) is characteristic, and is due to the double drainage (Atlantic and Pontic). Smelt, salmon, eel, sturgeon are missing in the Danube, hucho, Acipenser ruthenus in the Rhine. The alpine lakes and those of the Northeast have many specific fishes, especially Salmonides which have become landlocked. The most important food-fishes are perch, pike-perch, carp, dace, roach, tench, bream, pike, eel, lamprey; those of the German seas: mackerel, cod, halibut, plaice, flounder, sole, herring, sprat. The piscifauna is diminishing as the industrial development progresses (withdrawal and pollution of the waters).

The land and fresh water *molluscs* number 240, the genus Helix alone 40. Helix pomatia is the edible snail (snail farms in Swabia). The pearl mussel occurs in some districts. The Pontic Dreissena polymorpha has spread by migration and transportation through vessels into the larger rivers and is now spreading into their tributaries.

Marine food mussels are: the edible mussel, scallops, oyster (Ostrea edulis, an expensive luxury). Oyster beds are confined to the North Sea.

The *insect* fauna is numerous (6,000 beetles, 3,500 butterflies and moths), many are injurious, many useful. Immigrations can be traced from the Southwest and the East. [Praving mantis (Rhine), Cicada orni (Southwest), death's head moth, Sphinx nerii, migratory locusts]. The potato beetle has appeared here and there, the American Phylloxera has done enormous damage.

The great many Carabidæ are characteristic. The cockchafer (periodicity four years) is a serious pest. The gypsy moth (East and Bavaria), the processionary moths (Northwest and Northeast) are others.

Of the *Crustaceans* the common crayfish is widespread and a much-relished titbit.

We can distinguish three faunal districts: (1) the alpine region (chamois, snowhare, marmot, snowgrouse, chough, many insects and molluscs); (2) the mountainous regions with a western and eastern section; (3) the lowlands again with a western and eastern section.

Bibliography.— *Geography:* Kutzen, 'Das deutsche Land' (3d ed., Breslau 1880); Lehmann, R., and Kirchhoff, A., 'Forschungen zur deutschen Landes und Volkskunde' (14 vols. Stuttgart, 1885–1903, being continued); Partsch, 'Mittel-Europa' (Gotha 1904); 'Central Europe' (New York 1903); Penck, 'Das deutsche Reich' (Wien 1887); Ratzel, 'Deutschland' (Leipzig 1898); Richter, O., 'Das deutsche Reich' (2d ed., Leipzig 1898); Neumann, 'Das deutsche Reich in geographischer, statistischer und topographischer Beziehung' (Berlin 1878); Keil, A. von W., 'Neumanns Ortslexikon des deutschen Reichs' (4th ed., Leipzig 1903). Bädeker's Guide Books: 'Northern Germany'; 'Southern Germany.' Maps: 'Die Karte des deutschen Reichs' (scale 1:100,000, 674 sheets, published by the Royal Prussian Topographical Survey); 'Topographische Ubersichtskarte des deutschen Reichs' (scale 1:200,000, published since 1900 by the same); Vogel, 'Karte des deutschen Reichs' (scale 1:500,000, 27 sheets, Gotha 1893).

Geology: Lepsius, 'Geologie von Deutschland' (Stuttgart since 1889); Credner, H., 'Elemente der Geologie' (9th ed., Leipzig 1902). Maps: Lepsius, 'Geologische Karte des deutschen Reichs' (27 sheets, Gotha since 1894).

Flora: Drude, 'Deutschlands Pflanzengeographie' (Stuttgart 1896); Leunis, 'Synopsis der drei Naturreiche' (11 Batanik, 3 vols., Hanover 1883).

Fauna: G. Jäger, 'Deutschlands Tierwelt nach ihren Standorten eingeteilt' (Stuttgart 1874); Brehm, 'Tierleben' (3d ed., Leipzig); Leunis, 'Synopsis' (1 Zoologie, 2 vols., Hannover 1883).

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2. POLITICAL HISTORY TO 1871. The place of origin of the Germans is doubtful and even the theory, based on similarities of language, that they formed part of one great Indo-European race is no longer tenable. One race may readily impose its language on another, as the Germans on their Slavic neighbors.

Quite early we find German tribes in conflict with the Romans. Marius (in 101–02 B.C.) gained victories over bands of Cimbrians and Teutons that had penetrated to Provence and Northern Italy. Cæsar, after a struggle with the German Ariovistus, established the Rhine as a Roman boundary. Augustus undertook an invasion of Germany and his stepsons, Tiberius and Drusus — also, later, the son of Drusus, Germanicus — penetrated far into the land and built camps and fortifications, of which the remains are still to be seen. But the Cheruscan Arminius (or Hermann) at the head of a coalition of tribes defeated the Roman general Varus in the Teutoburg Forest (9 A.D.) and liberated Germany. Augustus began the *Limes* or great fortified wall which, under his successors, was extended across the whole frontier. The Germans were not always unfriendly and a considerable trade sprang up.

From being, in the days of Tacitus, a great number of semi-nomad tribes, the Germans coalesced into larger bodies called "stems" or "nations," among which the chief were the Goths, Vandals, Saxons, Burgundians and Franks (q.v.). The Goths were the first to accept Christianity — in the Arian form, indeed — and were represented by their own bishop at the council of Nicea. Throughout the 3d and 4th centuries the Germans made themselves more and more felt in the affairs of the Roman Empire, and thousands were allowed to settle on Roman soil. The advent of the wild hordes of the Huns (q.v.), who first crossed the Volga about 375 A.D., started the «wandering of the nations» and brought about the disintegration of the Western Empire and the rise of new kingdoms. Of these the only one that proved permanent was the kingdom of the Franks. Its survival is ascribed to the facts that it never lost touch with Germany, and that it adopted the Roman Catholic form of Christianity, thus finding support in the clergy of its conquered provinces.

Under the Merovingian Clovis and his sons an end was put to the remnant of Roman rule in Gaul. Provinces were wrested from the Visigoths (q.v.) to the south; while, to the east the Allemanians (q.v.) and Burgundians (q.v.) were subjugated. Though the race of the Merovingians (q.v.) steadily degenerated, the affairs of the new kingdom were well administered by the chief officials, the mayors of the palace, who contrived to make their own position hereditary and who handled the kings like puppets. Several mayors in turn distinguished themselves by quelling revolts, but the most brilliant achievement of all was the driving back of the Saracens by Charles Martel (q.v.). The battle near Poictiers (732 A.D.) was one of the world's great combats. The Saracen war is notable, too, as marking the beginning of the feudal system (q.v.). The first fiefs were lands of the Church, confiscated and parceled out by Charles Martel with the understanding that the persons thus favored should provide themselves with horses and perform military service.

Pepin, son of Charles Martel, put an end to the fiction of Merovingian kingship (752 A.D.) by imprisoning the last of the line and causing himself to be proclaimed king. This he did with the sanction of Pope Zacchary, who declared the Frankish crown hereditary, anointed Pepin's sons and pronounced a curse on those who should choose a king from any other line. Charles, known as «the great,» then brought the work of consolidating the kingdom to its culmination. He conquered the last free German tribes, notably the Saxons, with whom he warred for 30 years. He interfered in Italy, overthrowing the Lombard kingdom, and he conquered the wild Avars in the present Austria. He came forward as the champion of Pope Leo III, who had traveled to Germany to ask aid against a faction of the Romans. Charles conducted a sort of trial over the Pope's enemies, finally banishing them from Rome. Leo, in return, surprised Charles as he knelt in Saint Peter's by crowning him as successor to the old Roman emperors (800 A.D.). Charles, who had already subdivided the greater part of Germany into administrative districts, now centralized the government still more by requiring a new oath of allegiance and by sending out envoys with power to examine into the actions of all officials. It was a flourishing period not only politically, but also in learning, literature and art. Unfortunately Charles's son, Louis the Pious, proved unequal to the task of governing. He allowed the clergy to override him and did humiliating penance for alleged faults; he quarreled with his sons about their rights to the succession and became involved in civil war, which kept up after his death and only ended with the treaty of Verdun, in 843. (See PEACE TREATIES). This treaty divided civilized Europe into three parts, one nearly corresponding to modern France, another to modern Germany and the third being a strip between the other two, extending from the North Sea far down into Italy. After the death of Lothair and of one of the latter's sons this middle strip (Alsace-Lorraine) was divided between Germany and France (Treaty of Mersen (q.v.) 870), but remained a bone of contention down to our own day. Lothair's other son retained Italy.

From 885 to 888 the dominions of Charles the Great were reunited under his great grandson, Charles the Fat. Unable to cope with the invading Norsemen Charles the Fat was deposed and five independent kingdoms arose: Germany, France, Italy, Upper and Lower Burgundy. Germany itself narrowly escaped further subdivision, but the danger was averted by the election of Conrad of Franconia, chosen possibly because he was related to the Carolingian house. So slight was the political cohesion that Conrad went to war with the heads of each of the great duchies in turn — Lorraine, Saxony, Swabia and Bavaria — and that he felt compelled on his deathbed to urge the election of Henry of Saxony simply because that prince had been the most powerful of his opponents and could, it was hoped, hold the discordant elements together. It was a good choice. Henry proved a great organizer, training an army, building fortresses and overcoming the wild Hungarians and other Slavic tribes. He left Germany so consolidated that, at the coronation of his son and successor, Otto I, the heads of the duchies — Lorraine, Franconia, Swabia and Bavaria — did feudal, almost menial, service as cup-bearer, steward, chamberlain and marshal. Later, indeed, Otto had to put down rebellions on the part of all these dukes, and he came to rely on the ecclesiastical princes as the stanchest supporters of his throne. He inaugurated the policy, which proved unfortunate in the end, of endowing the clergy with great landed possessions. The benefit to him was that at every vacancy, as bishops had no lawful descendants, these lands reverted to the crown and could again be used to reward faithful service. Grants made to the nobles, on the contrary, came to be looked upon as hereditary family possessions, which, being let out in return for feudal service, assured the owners of large bands of faithful retainers. These local powers, especially the great dukes, were very often arrayed against the Crown.

Otto kept not merely the German, but also the Roman, Church in subjection. Drawn into Italian affairs by an appeal from the heiress to that kingdom, he put her enemies to flight, married the heiress, Adelaide, and himself assumed the titles of «King of the Lombards» and «King of the Italians.» He restored the empire of Charlemagne with the title of «Holy Roman Empire of the German Nation,» and, for misconduct, deposed the very Pope (John XII) who had crowned him emperor. Unfortunately these Italian interests drew Otto's successors away from their duties as German rulers. Again and again, with German armies, they descended upon Italy; each felt it a vital necessity to be crowned with the imperial crown at Rome. One consequence of their repeated absences was the loss of the supremacy over the Slavic nations on the German borders.

Otto's ecclesiastical policy was imitated by his son and grandson and led to a gigantic conflict with the papacy. It was a question ultimately as to who should control the elections of the German bishops. If the Pope, then he had simply to adjudge the rich German sees to his partisans; the emperor lost the supporters of his throne and the lands might practically as well have belonged outright to Rome. It seemed a life and death struggle, which accounts for its long continuance and for the venom displayed on both sides. There were wonderfully dramatic moments, like the penance at Canossa of Henry IV (1077), who amid winter snows appeared barefoot on three successive days before the Tuscan castle in which sat Pope Gregory VII, refusing him absolution, or the capture, in Rome itself, by Henry V, of Pope Paschal II and all his cardinals. This so-called investiture quarrel ended in 1122 with the Concordat of Worms, a compromise by which there were to be two investitures, one with the temporal estates by the emperors, the other with the spiritual power by the Pope. It had taken 50 years to arrive at this simple solution of the matter. See INVESTITURE.

New conflicts with the papacy broke out under succeeding rulers. Frederick Barbarossa warred for years with the semi-independent Lombard cities which were upheld by Pope Alexander III. Defeated at Legnano (1176) he was obliged to conclude the Peace of Venice with the Pope (1177), and that of Constance (1183) with the Lombard cities. See PEACE TREATIES.

The fact that Barbarossa's son, Henry VI, acquired Sicily by marriage, made the enmity of the popes and the emperors implacable. The papal possessions seemed to be held in a vise. It was this jealousy and fear that led to the papal determination to destroy the house of Hohenstaufen, root and branch. Other pretexts were never wanting. Frederick II was placed under the papal ban for delaying to accomplish his crusading vow and again for starting when forbidden. Crusades were preached against the emperor himself, who retaliated by capturing a whole shipload of prelates on their way to a council at Rome. It was a Titan struggle, the Sicilian kingdom being always the real bone of contention. The papacy conquered, with the aid of Charles of Anjou, who was promised the rule over Sicily. The last scion of the Hohenstaufen line, after losing the battle of Tagliacozzo (1268), was beheaded in the market-place at Naples.

Meanwhile the continued absence of the lawful rulers from Germany, and also the gifts of land and of privileges with which they had tried to win the support of the German nobles in the Italian campaigns, had led to the rise of many small and almost independent states. Frederick Barbarossa had still been strong enough to put down his most powerful vassal, Henry the Lion, and divide up his lands. Frederick II's death (1250) brought anarchy; and when, after an interregnum, Rudolph of Hapsburg was made king, it was practically a confederation over which he ruled.

Yet, strange to say, the age of the Hohenstaufens marks a great advance in civilization and well-being. It was the age of the crusades (q.v.) and of chivalry (q.v.), an age that marked an era in commerce, in learning and literature and in luxurious living. It is from this time that some of the great cathedrals date. Germany's boundaries, too, were pushed to the east and north by colonization and occasionally by war.

The 14th and 15th century kings left little impression on the history of Germany. They were men of no great force and they advocated no great principle. Henry VII and Louis of Bavaria renewed the old struggles in Italy but with no lasting results. The quarrel of Louis with Pope John XXII, indeed, is memorable for the literary productions that it called forth. The success of the *Defensor Pacis* of Marsilius of Padua was phenomenal. Never had the papacy been so assailed.

Charles IV was a man of no high aims, and his reign is chiefly remarkable for his promulgation of the so-called Golden Bull (q.v.) in favor of the seven electors. The earlier kings of Germany had been chosen by the whole body of the princes. At the election of Rudolph of Hapsburg, however, seven — the three archbishops (Mainz, Treves and Cologne) and the dukes of Saxony and Bavaria, the Margrave of Brandenburg and the Count Palatine — had been especially prominent. Bavaria's vote, indeed, was adjudged later to Bohemia. This electoral college became very powerful, exacting promises from the successful candidates and even deposing an emperor. The Golden Bull (1356) fixed the elaborate ceremonial of elections and the functions, rights and prerogatives of each of the seven electors. They were accorded almost sovereign rights.

Equally remarkable with the growth of the duchies and electorates was the development of the free towns. We find them banding together into commercial leagues and exercising real political power, such as setting their own king on the throne of Denmark. The Hanseatic League had its own fleet and its settlements in foreign lands. It enjoyed monopolies of trade and built great halls or warehouses that excite admiration to-day.

Another important organization was the Teutonic Order, a band of knights who had undertaken the conversion of wild Prussian tribes and had ended by building up a great state with the Marienburg for its centre. The order became rich and powerful and was visited by the greatest princes. It degenerated at last and became involved in a long war with Poland. By the Peace of Thorn (1466) the part of its territory known as West Prussia passed into Polish hands, while even the portion that was left became a Polish dependency.

Throughout the 15th century the cohesion of the different parts of Germany was slight. The interests of its rulers lay elsewhere: in Hungary, Bohemia, Italy or Luxemburg. Emperor Wenceslaus was deposed for staying away as much as eight years at a time. Sigismund made his first appearance four years after his election. Frederick III once retired in a fit of anger and did not come near a diet for 27 years. Yet the chief courts of justice followed the king's person! No wonder a secret tribunal, the Veme, could become the chief upholder of law and order and even venture to summon the king himself. Like the Hausa and the Teutonic Order the Veme had its flourishing days and then sank into disrepute; the end of the 15th century marks the decline of all three institutions.

After 1437 Hapsburgs, many of them inefficient, held the imperial throne in almost unbroken succession. After the Councils of Constance and Basel Frederick III, by a concordat or agreement with the Pope, renounced practically all the benefits that Germany had obtained. Frederick is noted for the fact that the great Renaissance movement began under his reign. His son, Maximilian, was a regular product of the Renaissance, versatile, talented, but lacking in balance. Maximilian was personally active in a scientific, literary and artistic way, and was full of political projects, some of which were almost too wild for belief, aiming as they did at making him world-ruler. He was, for instance, to combine the offices of Pope and emperor in his own person, and to succeed Perkin Warbeck as king of England.

In Maximilian's reign, independent of him yet a product of the Renaissance spirit, falls the beginning of the German Reformation. The invention of printing (about 1450) had provided a channel for the rapid dissemination of ideas, and pungent satires like Erasmus' 'Praise of Folly,' Brant's 'Ship of Fools,' and the anonymous 'Letters of Obscure Men' had mercilessly assailed abuses in the Church. Inflammatory writings of various kinds had made the peasants familiar with the idea of vengeance on the clergy and nobles, in whose favor they were overtaxed; while payments for the support of the papal court at Rome were becoming decidedly unpopular. Altogether, the ground was well prepared when the monk Martin Luther (q.v.) launched his demand for a discussion of the matter of papal indulgences, a demand that drew down an avalanche on his own head and that altered the whole course of German history.

Luther had soon found that the indulgence-preacher, Tetzel, was merely the instrument of higher personages and was not altogether to blame for his extravagant utterances. He then joined issue directly with Pope Leo X, who had authorized the indulgences, and with the archbishop of Mainz, who was to benefit largely by them. Luther's sovereign prince, the elector of Saxony, though a professed Roman Catholic to the end, came forward as the reformer's protector, and Luther, in response to his own demand for a fair hearing, was summoned to meet the Roman cardinal, Cajetanus, at Augsburg. The meeting proved fruitless, as did one with the legate Miltitz, who had been sent to Saxony to bribe the elector with the gift of the golden rose. A disputation with the theologian Eck, at Leipzig (1519), only served to clarify Luther's own ideas and to widen the breach with Rome. In three great writings he attacked the Pope and the doctrines of the Church, drawing down upon himself the papal ban. But the bull of excommunication was publicly burned by Luther at Wittenberg. The new emperor, Charles V, felt compelled, by a recent agreement with his princes not to condemn any one unheard, to summon Luther to his first German diet (Worms, 1521). By this time, if we can believe the Roman legate himself, nine-tenths of the German people were more or less in favor of Luther. Crowds gathered all along his route. His final word at Worms was: «I neither can nor will recant anything, for it is neither safe nor right to act against one's conscience. God help me. Amen.» He left as a convicted heretic, an edict signed by a majority of the princes declaring him in the ban of the empire. His life was in danger, but by order of the friendly elector of Saxony, he was attacked by seeming brigands and spirited away to the Wartburg, where he employed his time in preparing a translation of the Bible. Germany meanwhile was in a ferment and the number of polemical publications became enormous. Luther himself, by 1523, had published a hundred writings. Radical elements, men who claimed to be following Luther's own teachings, soon caused disturbances and drew him from his seclusion. His successful effort at restoring order in Wittenberg was one of the causes that prevented his arrest. His rôle in the great peasant revolt that broke out in 1524 was not so admirable. His incendiary eloquence had been taken by the masses as an invitation to iconoclasm. Discontent against the nobles, fanned by long oppression, had blazed up fiercely and 300,000 peasants rose in revolt, sacking castles and monasteries in all directions. Luther preached against them as «brands of hell,» and urged every man to strike them dead. The revolt was quelled and horrible vengeance taken, but Luther, naturally, lost many adherents, and the course of the Reformation was changed. Reliance had now to be placed on the princes rather than on the people. The Edict of Worms was never carried out, though still considered in force as late as 1530. Charles V was hampered by political considerations and by his wars with Francis of France and the Pope. His enmity to the latter once led him to remark that «Martin Luther might, after all, prove a useful man.» Luther was able at his leisure to organize his new church; and the diet of Spires, in 1526, unanimously passed a decree which practically allowed the Lutheran princes to conduct the religious affairs of their lands as pleased themselves.

The reversal of this decree, in 1529, by a simple majority vote, drew forth the «Protest» from which the «Protestant» party takes its name. Charles V had meanwhile gained the advantage both of the papacy and of France (treaties of Cambray and Barcelona) and his adherents were feeling very aggressive. They wished to force the issue, and they succeeded. The «Protest» was a technical one against the right of the diet to reverse the former unanimous edict. Charles himself earnestly sought to bring the schism to a peaceful end. He invited discussion and summoned conferences, acting not at all like the tyrant that many writers have made him out. He staved off war for 17 years, and then entered into it more on political than on religious grounds. Several Protestant princes fought on his side. This war with the Smalkald League, of which Elector John Frederick of Saxony and Margrave Philip of Hesse were heads, ended in the defeat and capture of those princes and in their long captivity. The electoral dignity in Saxony passed to the other branch of the house, the head of which, Maurice, had helped the emperor. But Maurice in turn, dissatisfied because Charles did not fully keep his promises, and alarmed at the emperor's attempt to have his son, Philip II of Spain, declared successor to the throne, headed a revolt which reduced Charles to great straits. A temporary peace was concluded at Passau (1552), but the final settlement was delayed by the disunity of the Protestant princes, the Margrave of Culmbach and Maurice of Saxony fighting on opposite sides. Maurice was killed at Sievershausen (1553).

Finally at Augsburg (1555) a general peace was concluded between the Protestant and Catholic princes; but by Ferdinand, not by Charles V — the latter preferring to abdicate rather than to make the needed concessions. The basis of the peace was free choice on the part of each lord of the land of the form of faith to be tolerated. There were, unfortunately, ambiguous clauses that led to later conflicts.

For the next 20 years Protestantism had the upper hand; but while the Roman Catholic party was strengthening itself by internal reforms, the Protestants, through dogmatic disputes, were becoming greatly weakened. Saxony (Lutheran) and the Palatinate (Calvinist) allowed their private enmities to ruin their cause as a whole. The Jesuits, marvelously trained for such work, made it their chief purpose to combat Protestantism. They secured the majority of votes in one bishopric after another, and even in the imperial diets and in the law courts.

A revolt of the Bohemians (Protestant) against the house of Hapsburg precipitated a European war. The acceptance of the Bohemian crown by Frederick V of the Palatinate was a challenge on political as well as on religious grounds; for the other German states could never suffer one of their number to hold two of the seven electoral votes. The Pope, the king of Spain, the elector of Bavaria, even the Protestant elector of Saxony rallied to the Hapsburgs. Frederick proved but a winter king and, before a year was over, was decisively defeated on the White Hill near Prague. New allies came to the fore in time: Bethlen Gabor, prince of Transylvania; Mansfeld, the Savoy condottiere; Christian of Brunswick; the Margrave of Baden Durlach, and, last but not least (1530), Gustavus Adolphus of Sweden. The emperor, Ferdinand II, would have succumbed to Gustavus Adolphus, who won a great victory at Brietenfeld and made a triumphal progress as far as Nuremberg, had he not, by enormous concessions, succeeded in inducing the mysterious Wallenstein, who was living in forced retirement, to re-enter his service. Wallenstein, endowed with dictatorial, almost royal rights, raised a huge army, compelled Gustavus Adolphus to withdraw from Nuremberg, and, finally, engaged him in a battle at Lützen, near Leipzig, that cost the Swedish conqueror his life. Later, indeed, doubts arose in many quarters as to Wallenstein's ultimate purpose. As far as we can judge now, it was to dictate a peace to Germany even at the risk of having to intimidate the emperor. Just at what stage his dealings with the Swedes and Saxons became treasonable is hard to establish, but treasonable they were at the last. An order was given for his arrest, living or dead; and some of his own officers joined in a deliberate plot to kill him. His room was invaded, he himself stabbed in the breast (1634).

The war now entered a new phase. It was no longer merely a question of religious interests, for Catholic France joined in on the side of the Protestants. The struggle finally became one merely for compensation and costs. For four years it went on simultaneously with peace negotiations (at Osnabruck and Münster in Westphalia) which ended in an agreement as to mutual religious toleration and in a readjustment of the map of Europe. Unfortunately the boundary between Germany and France was established by an ambiguous formula and, later, led again to war (1688–97).

The most important development in the period following on the peace of Westphalia was the rise of the Brandenburg-Prussian monarchy. See Prussia. After the Great Elector (1640–88) had consolidated his possessions, his son, Frederick III, was allowed to assume the royal title as compensation for aid furnished the Hapsburg emperor in the Spanish Succession War. The Spanish throne, vacant by the death of the childless Carlos II, was claimed by Emperor Leopold for his son Charles (VI), and by Louis XIV for his grandson, the duc d'Anjou. Against Louis XIV was arrayed the grand alliance, consisting of England, Holland, Austria, and the majority of the German states. With Louis were the electors of Cologne and of Bavaria. The war, which lasted 13 years, showed an almost unbroken series of victories — Blenheim, Turin, Ramilies, Malplaquet and others — for the Grand Alliance. Yet by the Treaty of Baden (1714) the German states gained absolutely nothing, England and Austria having already secured their own advantages by the treaties of Utrecht and Rastadt.

Meanwhile in Prussia (see Prussia) the first king, Frederick I, had been succeeded by the great organizer, Frederick William I, who remodeled the administration, brought the army to the highest pitch of efficiency, and placed the finances on a good basis. It was these reforms that enabled Frederick the Great to play a commanding rôle in European history. Scarcely had Frederick come to the throne (1740) when he made a descent on the Austrian province of Silesia, advancing old claims of his house, not altogether unwarranted, to a portion of the territory. Received with open arms by the inhabitants of Breslau, who had chafed under the Austrian rule, he won the battles of Mollwitz and Chotusitz, and compelled the Archduchess Maria Theresa to conclude the Peace of Breslau (1742) which left Silesia in his hands. Austria and England continued the war with France. Austria's growing strength and prestige, and especially the fact that, in 1744, she concluded a treaty with Saxony, determined Frederick to re-enter the arena. He did so ostensibly in support of the new emperor, Charles VII of Bavaria, the only man not a Hapsburg chosen to that position in 300 years. In the Bohemian campaign of 1745 Frederick suffered severe reverses, but at Hohenfriedberg, at Sohr, and at Kesselsdorf he gained important victories and was able to obtain at Dresden the same terms as in the Peace of Breslau, compelling Saxony, besides, to pay an indemnity. Charles VII having died, Maria Theresa's husband was now elected emperor, and took the name of Francis I.

Eleven years later Frederick, learning through secret channels that Maria Theresa, the Czarina Elizabeth, and Augustus of Saxony-Poland were plotting the dismemberment of Prussia, concluded the Convention of Westminster with England and prepared for a new war (1756). France, where Madame de Pompadour was now all powerful, joined the two empresses. Madame de Pompadour boasted that the Treaty of Versailles (May 1750) was her work. It was followed by a second, offensive, treaty signed at the same place. (See PEACE TREATIES). The odds against Frederick in this Seven Years' War were very great, for though England sent him money and though she maintained an army of Hanoverians, she sent him no direct reinforcements. The allied forces often outnumbered his own by two and three to one, yet in the teeth of such superiority he gained some of his most splendid victories: Rossbach, Leuthen, Zorndorf, Liegnitz and Torgau. There came a time, indeed, when even victories were of small avail, for there was no way of filling the ranks. The death of the Tsarina Elizabeth (1762) did more for Frederick than many battles and even neutralized the effect of the desertion of England, which country, under the new Bute ministry, suddenly left him in the lurch and tried to compel him to make peace. The new Tsar, Peter the Third, became Frederick's ally but was deposed before his troops could be of much assistance. France, however, had also withdrawn from the struggle and concluded the preliminary Peace of Fontainebleau with England. Maria Theresa saw the helplessness of continuing alone the task she had been unable to accomplish when aided by powerful allies, and sent an envoy to treat for peace. After seven weeks of negotiation an agreement was signed at the castle of Hubertsburg (1763) which in every respect was a return to the condition of things before the war.

Later Maria Theresa and her son, the Emperor Joseph, joined with Frederick and with Catherine of Russia in dismembering Poland — a step which the demoralization of the Poles invited if it did not excuse. Though Frederick the Great's share was but one-third the size of that of either of his allies, it was doubtless of greater proportionate value, as it comprised West Prussia, the land that had once belonged to the Teutonic Order, and rounded out his domains. Austria and Prussia once more went to war (1778–79), this time with regard to the Bavarian succession, claimed by Joseph. The acquisition of a German electorate would have assured the preponderance of Austria in all the affairs of the empire and would have been a fatal blow to Prussia. Frederick and his brother Henry took the field in person, but no battle of importance took place and the war was stopped by the intervention of France and Russia. Frederick devoted his last years to organizing a league of German princes for mutual protection against Austria. It was a powerful weapon, for three of the members were electors and might readily be in a position to frustrate the choice of a Hapsburg as emperor.

Frederick's policy of opposing Austria with the aid of other German states was not carried further by his successor, Frederick William II. Indeed the latter sided with Austria in an attempt to intimidate the French revolutionists, and joined with the Emperor Leopold II in the declaration of Pillnitz (1792). Frederick William himself took the field. The blatant manifesto of his chief commander, the Duke of Brunswick, roused the French to fury and encouraged them to win the battles of Valmy and Jemmappes (1792).

Frederick William's attention was diverted from France by further partitions of Poland (1793 and 1795) which gave him a vast territory; but the new provinces were badly administered and proved a source of weakness rather than of strength. Prussia had greatly lost her prestige even before Frederick William consented to the disgraceful Peace of Basel (1795), which secretly bound Prussia to non-interference even though France should annex the left bank of the Rhine. Austria was left to continue alone the struggle that had been begun in common, but in 1797 concluded the Treaty of Campo Formio, which contained secret clauses about the left bank of the Rhine similar to those signed by Prussia.

The Holy Roman Empire, as it was still called, was in an incredible state of disintegration. At the Congress of Rastadt (1798) the French envoys openly came out with their demand for Rhenish territory, and the dispossessed princess clamored for compensation elsewhere in Germany. A witty publicist thereupon drew up the last will and testament of the old empire. Austria renewed the war, indeed, but was defeated at Marengo and Hohenlinden and, by the Peace of Lunéville (1801), was obliged to take active part in the dismemberment of Germany. An executive council of the Diet, called the Imperial Deputation, passed a decree (1803) which practically annihilated more than 200 German states and divided up 50,000 square miles of territory. The compensations were arbitrarily apportioned so as to serve French interests, Napoleon Bonaparte's idea being to strengthen the South German states and create a "Third Germany" to be under his own influence. He treated Germany as conquered territory, sending his troops to occupy Hanover, carrying off and putting to death the Duke of Enghien, who thought himself safe on Baden soil, and causing a bookseller of Nuremberg to be shot for selling a harmless publication which bewailed the general state of affairs.

The murder of the Duke of Enghien was one of the occurrences that roused Alexander of Russia to form a third coalition which was joined by Austria and England, but not by Prussia. The Napoleonic victories at Ulm and Austerlitz (1804) routed this coalition, and by the Peace of Pressburg (1805) Austria was divested of 28,000 square miles of territory and 3,500,000 inhabitants; while Württemberg and Bavaria, which had aided Napoleon, were raised to the dignity of kingdoms. They formed the nucleus of the Rhine Confederation, which now formally repudiated the jurisdiction of the Holy Roman Empire. This caused Francis I to abdicate the throne (1806), though he had carefully provided for the future, in 1804, by having the Hapsburg possessions declared an empire by themselves.

Prussia was now goaded into war with Napoleon by violation of her territory and by double-dealing with regard to Hanover. But never had a seemingly strong state shown more abject weakness; never was military organization more faulty. The defeats of Jena and Auerstädt (1806) were overwhelming and the fortresses with which the land was studded fell like houses of cards. A brief rally at Eylau, where the Prussians were joined by Russian forces, was followed by the defeat of Friedland which frightened Alexander into signing a truce. By the Treaty of Tilsit (1807), Prussia was humbled in the dust and was shorn of half of her provinces. They went to form the kingdoms of Westphalia for Jerome Bonaparte, and the duchy of Warsaw for the king of Saxony.

Then began a time of moral and physical regeneration. In every department arose earnest workers: Stein and Hardenberg, Scharnhorst and Gneisenau, Jahn and Arndt, Fichte and Schleiermacher. Austria, too, arose from her lethargy, but struck her blow at Napoleon too soon and collapsed after Wagram (1809). Napoleon made Prussia join him in his invasion of Russia, but his disasters gave the Prussians their longed-for opportunity. General Yorck, in command of a Prussian auxiliary force, renounced his allegiance to France, and even the phlegmatic Frederick William III was finally carried away. Landwehr and Landsturm were called out; England, Russia and Austria came to Prussia's aid and the war of liberation began (1813). Napoleon returned from Paris with a new army and gained the battles of Lützen and Bautzen. But Blücher showed indomitable energy. After a series of defeats and one more victory Napoleon was penned in in Leipzig, and only escaped after an ultra-bloody three days' battle. He was eventually followed into France and was forced to surrender. His return from Elba and his defeat at Waterloo are too familiar to be more than mentioned. See WATERLOO, BATTLE OF.

The Congress of Vienna left Germany in a very unsatisfactory condition, as a loose confederation with Austria at the head, and with a Diet that was to meet at Frankfort. There was no central army, no treasury. The only means of coercion was federal execution, the deputing of one state to punish another.

The policy of the reactionary Austrian minister, Metternich, dominated the next 30 years. He made it his life-work to prevent the German states from introducing constitutional government. He saw conspiracies everywhere and became the bitter enemy of the Burschenschaften and Turnvereine, comparatively innocent student organizations which held meetings like the Wartburg and Hambach festivals (1817 and 1832), where there were inflammatory demonstrations. The murder of the Russian agent Kotzebue by the Jena student Karl Sand enabled Metternich to thoroughly frighten Russia and Prussia, which had formed with Austria a «Holy Alliance.» Draconian decrees were passed, and a sort of revolutionary inquisition was established at Mainz (1819). The Burschenschaften were dissolved, but the discontent of the students simmered on until 1848.

The hope of Germany, as we know now, lay in the supremacy of the strongest state. It was a great step forward when, between 1828 and 1842, Prussia managed to enroll in her Customs Union all the other German states except Austria. Commercial hegemony then paved the way for political leadership. One deterrent was the imperviousness of the Prussian king to liberal ideas. Frederick William IV steadfastly refused to give his subjects a written constitution, though at times using language that implied sympathy with the popular demands. In 1848 the happenings in France unchained the spirit of revolt all over Germany. There were bloody uprisings in Berlin and Vienna, and a national parliament met at Frankfort. The crown of a new empire was offered to Frederick William IV, but he spurned it as a crown plucked from the gutter and reeking like carrion. He got the better of the Prussian Revolutionary Parliament, but felt obliged to grant a constitution which, as he wrote to a friend, was liberal enough to make his own stomach ache. It is the constitution still in vogue in Prussia. The Frankfort Parliament was finally dispersed by force of arms, and Prussia endeavored to form a «Union» of which she should be head (1849). At Olmutz (1850), at the peremptory summons of Austria, she desisted, and consented to a simple restoration of the old confederation, with its diet, as before, at Frankfort. To this diet the Prussian delegate was Otto von Bismarck who, for 10 years, made it his special task to combat Austrian pretensions. Later he attacked the problem by strengthening the Prussian state, being called by King William to be prime minister, and so put through a great increase in the Prussian army. This was done by technically unconstitutional means and in the teeth of violent opposition from the Parliament, which was not appeased until the utility of the new measures had been proved beyond a doubt in the victories over Denmark (1864) and over Austria (1866). The Danish War had been undertaken in common with Austria because of Danish efforts to incorporate the province of Schleswig-Holstein; the conflict with Austria had arisen with regard to the disposal of the spoils. Austria, supported by the minor German states, had threatened federal execution. Prussia had accepted the challenge and declared her intention of founding a new confederation which the other states were to be compelled to join. After the swift overthrow of Saxony, Hesse, Hanover and Nassau, and after the great victory over Austria at Königgratz, this plan was easily put into execution. Prussia became the head of the North German Confederation, from which Austria was excluded. By the mediation of the French emperor, Napoleon III, it was stipulated that the South German states might form their own organization, which they never did. Prussia was allowed to annex much of her conquered territory.

Napoleon's own prestige demanded that France, too, should have some annexations to show. He begged for the Rhenish provinces, he tried to buy Luxemburg. But Bismarck was inexorable. Hatred of Prussia became a dominant passion with the French, and when, in 1870, a pretext was found in the candidacy of a Hohenzollern to the vacant throne of Spain, the nation rushed joyously into war. When the candidacy was withdrawn the chamber sent an insulting demand that the king of Prussia should promise that it should never be renewed. Bismarck's publication of a terse version of the incident aroused intense excitement in Germany; but it was the French who began hostilities. Their total want of preparation and the wonderful organization of the Germans, for which Moltke was largely responsible, brought about the long series of French defeats and resulted in the capture of the two main armies, as well as of the emperor's own person (Metz and Sedan). After the successful siege of Paris the war closed with the treaty of Frankfort (May 10, 1871). Already on 18 January, by invitation of all the states, King William of Prussia had assumed the Crown as German emperor.

Bibliography.— Andrews, 'Contemporary Europe, Asia and Africa' (Philadelphia 1902); Armstrong, 'Charles V' (London 1902); Bernhardi, 'Germany and the Next War' (London 1912); Baring-Gould, 'Germany, Past and Present' (ib. 1881); Blum, 'Das deutsche Reich zur Zeit Bismarck' (Leipzig 1893); Bryce, James, 'The Holy Roman Empire' (New York 1892); Bulle, 'Geschichte der neuesten Zeit, 1815–71' (Leipzig 1886–87); 'Cambridge Modern History' (Vols. X, XI, XII, New York 1903–12); Dahlmann-Waitz-Herre (eds.) 'Quellenkunde der deutschen Geschichte' (Leipzig 1912); Dawson, 'The Evolution of Modern Germany' (New York 1913); Debidour, 'Histoire diplomatique de l'Europe, 1814–78, (Vols. I and II, Paris 1891); Denis, 'La fondation de l'empire allemand' (ib. 1906); Eltzbacher, 'Modern Germany' (London 1905); Erdmannsdörffer, 'Deutsche Geschichte vom westphälischen Frieden bis zum Regierungsantritt Friedrichs des Grossen, 1648–1740' (Berlin 1892–94); Fisher, 'Mediæval Europe' (2 vols., London 1898); Gardiner, 'The Thirty Years' War' (1874); Gebhardt, 'Handbuch der deutschen Geschichte' (2 vols., Stuttgart 1910); Gutsche et alii, 'Bibliothek deutscher Geschichte' (ib. 1876 et seq.); Headlam, James, 'Bismarck' (London 1899); Henderson, E. F., 'Short History of Germany' (latest ed., New York 1916); id., 'History of Germany in the Middle Ages' (ib. 1894); id. 'Blücher and the Uprising of Prussia against Napoleon' (ib. 1911); Hurd and Castle, 'The German Sea Power' (London 1913); Hill, 'History of Diplomacy in the International Development of Europe' (6 vols., New York 1905–14); Janssen, 'History of the German People' (London 1907); Lamprecht, 'Deutsche Geschichte' (12 vols., Berlin 1891–1909); Lowell, 'Governments and Politics in Continental Europe' (New York 1896); Malleson, 'The Refounding of the German Empire, 1848–71' (London 1893); Müller, 'Political History of Recent Times, 1816–75' (New York 1882); Murdock, 'The Reconstruction of Europe' (Boston 1889); Nitzsch, 'Geschichte des deutschen Volkes bis zum Augsburger Religionsfrieden' (3 vols., Leipzig 1892); Marcks, 'Germany and England: Their Relations in the Great Crisis of European History, 1500–1900' (English trans., London 1900); Oncken, 'Das Zeitalter der Revolution, des Kaiserreiches und der Befreiungskriege' (Berlin 1892); Priest, 'Modern Germany'; Reddanay, W. F., 'Frederick the Great and the Rise of Prussia' (London 1904); Roberts, 'Monarchial Socialism in Germany' (New York 1913); Schierbrand, 'Germany: The Welding of a World Power' (ib. 1907); Stubbs, 'Germany in the Early Middle Ages' (ib. 1908); id., 'Germany in the Later Middle Ages' (ib. 1908); Seignobos, 'Political History of Europe Since 1814' (ib. 1900); Seeley, 'Life and Times of Stein' (London 1879); Treitschke, 'Deutsche Geschichte im neunzehnten Jahrhundert' (Leipzig 1879–94); Tout, T. F., 'The Empire and the Papacy' (1898); Tuttle, 'History of Prussia' (3 vols., Boston 1888); Von Bülow, 'Imperial Germany' (New York 1914).

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3. POLITICAL HISTORY 1871–1918.

After the foundation of the new German Empire, on 18 Jan. 1871, Bismarck (q.v.) was at the helm and directed national affairs almost according to his own supreme will. The old king of Prussia, William I, now German emperor by the grace of the other rulers of the non-Prussian parts of the territory, had an almost blind confidence in the wisdom and energy of his Chancellor, and merely lent the great weight of his personal prestige to Bismarck in directing affairs, and the young nation, still in the process of consolidation, followed more or less reluctantly the lead of the "Man of Blood and Iron," being thoroughly cowed by the glittering successes on battlefield and in statecraft with which he curtly silenced his opponents on all critical occasions. From a mere "geographical idea," which Germany had been up to 1866, she had suddenly and portentously risen to be a most powerful and aggressive entity before the eyes of amazed contemporaries. Yet the task of internal consolidation was a herculean one, requiring not alone almost autocratic prerogatives — such as, indeed, the new imperial constitution, being of Bismarck's own drafting, clothed the Chancellor's office with — but infinite tact, patience and sympathetic insight. But Bismarck, after all, was a Prussian, even a "Junker" (younker) by descent and practical training, and tact and patience were scarcely a part of his equipment. He certainly had spared the finer susceptibilities of the minor crowned heads of Germany very skilfully to enable the establishment of an imperial ruler at all, notably in the case of those of Bavaria and Württemberg, and during his régime he did not depart from this line of internal policy. But it was otherwise in sundry other respects. He certainly proved not nearly so effective in his internal policy as he had been as a state-builder. This came to be seen very soon after the Peace of Frankfort had ratified the successes of 1870–71. The so-called *Kulturkampf* (q.v.) broke out in 1873 and continued virulently till 1879. This split the whole nation into two unequal halves, the Protestant and the Catholic, antagonizing each other and bearing the seed of bitter and ceaseless internecine strife. It came soon after, and as an outcropping consequence of, the declaration of papal infallibility by the Vatican Council, this novel dogma having undoubtedly a tendency in Germany of arraying the spiritual against the temporal power. The so-called *Maigesetze*, or May laws, were passed by the Reichstag, and these amongst other things decreed the expulsion of the Jesuits and similar bodies from German soil. They also denied, in a number of crucial points, the right of the Catholic hierarchy of interfering in many administrative state matters, in «mixed» and civil marriages and in the intimate supervision by bishops of the family life of their flocks. High tension prevailed for years; under the surface a religious war was waged in every town and hamlet. Several unyielding archbishops in Prussia were incarcerated. Bismarck, in one of his embittered moods, declared in a Reichstag speech that he was firmly bent on upholding the supremacy of the state, and that he should never «go to Canossa» (a historical reminiscence of the time of Emperor Henry IV). But in the end, after the lapse of six implacable years, he yielded nevertheless in a measure to papal diplomacy, and a compromise with the Vatican was effected, Leo XIII meanwhile having succeeded Pius IX. In part this was due to a new and just as formidable internal foe having loomed up, requiring all the strategical ruthlessness of the dreaded Chancellor; namely, the Socialists. Against their passionate agitation Bismarck got the Reichstag to enact the so-called *Ausnahmegesetze* (or exceptional laws), which put millions of Germans, both men and women, under the ban. These drastic laws, too, were passed for a specified term of years. They drove many thousands of Germany's skilled artisans, small tradesmen, etc., Socialists by faith, into neighboring and less autocratically administered countries, and also to the United States, where most of them became good and useful citizens. The entire Socialist press was suppressed throughout Germany, but a vigorous contraband trade in Socialist literature was, just the same, carried on constantly, especially across the Swiss border.

In 1878, at the Congress of Berlin, Germany's preponderance in the affairs of Europe became patent to the eyes of the beholder. This body of delegates, embracing the foremost statesmen from the principal countries of Europe, was commissioned to adjust the final outcome of the Russo-Turkish War. Bismarck presided at it in Jove-like style, although he publicly vindicated to himself merely the humbler title of «the honest broker.» The Congress ended with Russia's being stripped of nearly all the fruits of her victory, notably of her much-coveted position as arbiter in and protector of the Balkan region with its Slavic populations. It left a bitter sting behind in Russia. The Russian Prime Minister, Prince Gortchakoff, a rival of Bismarck's in the arena of high statesmanship, turned his envenomed foe, and the Russian people as a whole attributed chiefly to Bismarck, and far less to the British wizard, Beaconsfield, their being juggled out of their spoils at the conclave. As a matter of fact, Russian enmity thenceforward became active and, at times, virulent and embarrassing to Germany. Russia began to turn her eyes away from the Spree and toward the Seine. The Franco-Russian entente virtually dated from that hour of impotent chagrin. Thus, from an occasion when the new and frowning empire, founded on war and with a primarily militaristic basis, had apparently arrived at the apogee of power and influence, from its very zenith of glorification, dates, in truth, one of the hidden springs of the great war that exploded in 1914; from a symbol of tower-like strength it became a symbol of inner weakness.

Enormous sums of money and gigantic labor were devoted by the new Germany to the perfection of her system of internal canalization. Her chief rivers, the Rhine and Elbe, Weser and Oder were thus tapped and connected with each other, and cheap water transportation contributed greatly to traffic and trade. From one point of view the most important of these canals, viz., the one joining the Baltic to the North Sea, commonly styled the Kiel Canal, doubled the availability and striking power of the new and steadily growing German navy. It was inaugurated on 19 June 1895 amid impressive ceremonies by the young emperor. Its construction, all told, had cost some $80,000,000. The organization of the judicial system, to correspond in scope and competence to the duties imposed upon the empire as such, was an important task which it took years to accomplish. An imperial court was established, with its site in Leipzig, a court whose functions in most respects are not dissimilar to those of the United States Supreme Court at Washington. More and more uniformity of jurisdiction became the fact. Criminal and civil procedure were made of one kind throughout the country as a whole. Federal laws were enacted dealing with trade organization, banking, merchant marine, patents, etc. The Imperial Civil Code, after labors lasting for many years, was adopted and went into effect in 1900. A whole group of laws, beginning in the '80's and continuing into the new century, was framed, the so-called *Sozialgesetzgebung* (social benefit legislation), having for aim the material safeguarding of the bone and sinew of the nation — the laboring element, the skilled toilers, the shopkeepers and smaller dealers — and started by Bismarck himself, being originally a sop thrown to these hitherto oppressed and disaffected strata of the population from which the Socialists had chiefly recruited themselves. But this type of legislation was steadily extended, long after Bismarck's dismissal, and attained a couple of years before the outbreak of the great war a fairly comprehensive point, as it took care of its beneficiaries in cases of non-employment, of sickness, of invalidism, of old age, of death and devoting to these purposes (although the enforced weekly contributions of the toilers themselves furnished the bulk of the funds) on the part of government and employers some 250,000,000 marks annually. In all some 17,000,000 of the population of Germany profit from these laws. Again, as a parallel to the already existing statutes enabling cities and towns to regulate their own municipal affairs, undisturbed by the state and nation, a body of laws was enacted conferring similar prerogatives on the rural communities, the *Landgemeindeordnung*. These two sets of laws have powerfully aided decentralization and local independence. Bismarck, who all his life abhorred red tape, had also initiated the latter sort of legislation.

Meanwhile the movement looking toward the acquisition of a colonial empire abroad had set in. Bismarck all his life had not favored this much. He questioned, for one thing, the fitness of the German people as colonizers. He also dreaded complications for his foreign policy growing out of it. He knew that at best scarcely any territories in the temperate zone, and hence capable of settling many German emigrants, were available for appropriation. Nevertheless, the current of feeling in favor of colonies, greatly promoted by the emperor, ran so high in Germany for many years that at last he was forced to yield. From 1884 on, whenever opportunity offered, the German people have seized, purchased or otherwise acquired territories for colonial purposes, the official title for such lands being *Schutzgebiete*, i.e., protectorates. In this way, until the war deprived her of them, Germany gradually accumulated territory (nearly altogether located in the torrid and tropical zones) in various quarters of the globe many times larger than her own home territory. This comprised German Southwest Africa (mostly arid soil, but the only one of her colonies in which white men can live permanently and raise families), adjoining British South Africa, next Kameroon, Togo, German East Africa, German New Guinea, the Bismarck Archipelago, Samoa and some smaller groups of islands, all acquired before or in 1890. Then she obtained the Carolines, as well as in China the small territory of Kiaochou. Opinions are rather divided as to the kind of use made by Germany of her colonies. Certainly, the first 20 years undeniable blunders were made. The formidable uprising of a warlike tribe in German Southwest Africa, the Hereros, and its suppression with great bloodshed and cruelty, made much talk. But on the whole it appears to be the fact that little by little — during the altogether but 30 years that Germany had to gain practical experience — in several of her larger colonies she began to be fairly successful, both as to commercial results and as to administrative methods. The oft-tested "trade follows the flag" seems to have once more held true. And certainly it seems to be also true that in some of the more valuable and larger German colonies, notably in German East Africa and in German Southwest Africa, the natives during trying war times showed as much attachment to their German overlords as they could reasonably be expected to show in a cause of which they understood nothing. Some of the intrinsically most valuable colonial lands once held by Germany were exchanged for the tiny, but in naval strategy extremely vital, island of Heligoland, near the mouth of the Elbe River, by the successor of Bismarck, General Count Caprivi, a complete disbeliever in German colonial aggrandizement. These were the sultanate of Sansibar and the lands of Uganda and Witu in Africa, now belonging to Great Britain.

Returning to Bismarck, the year 1888 brought on not only the final demise of his nonagenarian "old master" (as he spoke of him), William I, but also, after but a three-months' sorrowful reign, that of his son, the more liberal-minded Frederick III, and after acting for so many years very successfully the part of the major domus, the real head, under his attached sovereign, a man singularly free of personal ambition, the stern old Chancellor stood facing the young and impetuous successor, William II. It was a situation inherently impossible for any length of time. William II all through his reign has only tolerated for any length of time mediocrity in his immediate entourage. He could not brook such a mentor as Bismarck. After some 20 months of semi-hostilities, after the patching up of several quarrels between them, the complete rupture came at last, in March 1890, and the gnarled old statesman formally resigned and retired to his bosky Tusculum at Friedrichsruh, near Hamburg. There the present writer paid him, eight years later and but six weeks before his death, a visit for the purpose of learning the old statesman's views regarding the Spanish-American War. The eight years between 1890 and 1898 Bismarck spent mostly in watching impotently the "new course," the "zigzag course," as he termed it, and in cursing the "young man in Berlin" under his breath. The immediate cause of the rupture, in March 1890, had been the refusal of the young monarch to sanction renewal of the anti-Socialist special legislation already referred to. Freed from the chafing restraint exercised by the older and more experienced man, the Kaiser in his characteristically impulsive way devoted himself to the task of reconciling the Socialists to his person, to his methods, to his aims. In all of which, although no more anti-Socialist laws had been passed, he failed completely. Then William II turned and himself became the virulent foe of the Socialists, terming them in one of his most typical speeches, "Eine Rotte Menschen, nicht wert, den Namen von Deutschen zu tragen" (a lot of men unworthy to bear the name of Germans), and not until after the great war itself had started, in 1914, did William II again speak to one of them.

Up to 1879 the young empire, largely to foster its nascent industry, had adhered to low import and export duties. But in that year, internal political considerations rendering it inadvisable for the government longer to resist the steady pressure exerted by the land-holding classes, the so-called Agrarians (identical in the main with the rural aristocracy of the Prussian provinces lying east of the Elbe, and whence the larger half of the higher and more influential office-holders and army commanders are drawn), a high protective tariff was enacted. This and subsequent even more drastic measures of a similar kind bore with particular weight upon the lower classes, the humbler breadwinners of the industrial towns, since it greatly heightened the price of all foodstuffs without a corresponding rise in wages. Some articles of diet, meats particularly, increased almost to prohibitive rates. This state of things remained unaltered from early in the nineties on. Reciprocity treaties were concluded, one after the other, with Austria-Hungary, Russia, the Scandinavian countries, Holland, Belgium, Switzerland, etc. These in a measure shifted economic conditions in this respect. From then on German industry grew rapidly in volume and efficiency. In 1876, at the Philadelphia Exposition, the imperial commissioner, Reuleaux, in his official reports, had been obliged to stigmatize German industrial exhibits as "cheap and nasty." Now, under these novel conditions, German industry had rapidly become so formidable a competitor that England decreed her "Made in Gremany" mandate, vainly attempting thereby to stem the tide of German exports. Part of what William II designated as his "Weltpolitik" consisted in this strenuous race for mercantile supremacy, and he took good care, in his speeches to his people in season and out of season, to impress them with the necessity of a constant growth as an exporting nation. Similarly, German shipping and German trade increased by leaps and bounds. The world began to take note of the «German danger.» But in 1902 a new tariff law passed the Reichstag, once again enhancing the duties on foodstuffs, once more with the aim of favoring the Agrarian (or younker) interests of the nation. The Socialist party coined as an election slogan the phrase «bread usury.» At the new Reichstag elections, in June 1903, it was clearly shown that the humbler classes condemned outright the new tariff. While the Socialists increased their delegation in the Reichstag from 56 to 81 and their popular vote from 2,107,000 ballots to over 3,010,000 cast, the Agrarian vote considerably diminished and even the biggest party, the Centre, mustered but 1,875,000 votes. However, the non-Socialists in the Reichstag pooled their issues and showed a united front in that body, thus enabling them to enact the new *Zolltarif* of 1904, granting none of the Socialist demands. However, even this unwise legislation was not able to retard the rapid increase of Germany's industrial progress. It outdistanced England's, relatively speaking, in many quarters of the globe.

While the chief claim of his grandfather, William I, to the title of a great ruler, had consisted not so much in his own initiative and in his own qualities, but rather in a wonderful knack possessed by him in unerringly picking the right man for the right place and then modestly stepping back and allowing him a free hand, William II prided himself on the contrary in always leading the van in all that he deemed might advance the interests and power of Germany. In the endeavor to found a colonial empire, in the promotion of German industry, trade, shipping, in all the measures that were calculated to consolidate the nation, in a reform of the German school system, in the fashioning of the most powerful army on the globe, and lastly in the creation of a huge navy William II was always the driving agency, the determining factor. He aimed at turning the German school system into one having a purely national and patriotic basis, so that the German boys and youths should not become, as he put it, «young Romans or Greeks,» should not deem the acquisition of classic lore the chief desideratum, but rather first become deeply versed in the language, literature and history of their own country and race; and in a measure he succeeded. With his own conviction that Germany needed a navy large and efficient enough to cope with any foe, no matter which, on the water, the overwhelming bulk of the nation for years and years did not agree. Reluctantly only the German people followed him on this path. In the south and in the interior provinces especially, those far removed from the *Waterkant* and unfamiliar with the sea, the Kaiser's naval program was never popular. Nevertheless, with resistless energy he pursued his way, overcoming all obstacles. The German navy, in its development, was based, first, on the Reichstag act of 1900, supplemented by those of 1906 and 1912. The latter program was to have been completed by 1923 and provided for a fleet of 41 first-class battleships, 12 battlecruisers and 30 smaller cruisers, with an additional 18 cruisers for foreign service and also to replace worn-out vessels. In 1914–15 the naval budget was $117,000,000 and its man power comprised 3,700 commissioned officers, with 75,468 men. For a decade and more before the outbreak of the war the keynote of Germany's foreign policy was a growing estrangement from Great Britain. At the bottom of this feeling was commercial rivalry. The Kaiser aided this by his indiscreet utterances on the occasion of the Jameson raid and during the early stages of the Boer War in South Africa. In the Russo-Japanese War Germany's attitude was friendly to Russia. Then came the first Morocco episode, Germany thus testing the strength of the Franco-British understanding. It led to the very brink of war in 1905, until at the conference of Algeciras the moot points were settled, greatly to Germany's dissatisfaction. To her dismay even her nominal ally, Italy, had sided against her at Algeciras. Bülow, then Chancellor, in an attempt at self-irony, referred to the incident as an «extra tour.» Twice before since 1871, still under the Bismarckian era, war with France had been near, in 1875 and in 1887 (during the Boulanger obsession), but had been averted by the consummate statesmanship of the old Chancellor. With the Kaiser, being in fact his own Chancellor, things could not run so smoothly. Largely this was owing to the peculiar mental and moral makeup of William II. A firm believer in the divine origin of his office, as confessed by one of his most noted utterances, wherein he declared that he owed his «awful responsibility toward the Creator alone, wherefrom no man, no minister, no parliament, no people can relieve the sovereign,» he harbored most exalted notions of his own importance. He lacked entirely the deep human humility of his grandfather, although in many things he took the latter for a model. No ruler during historical times has been so profuse and varied a public orator, nor one so careless in shocking enlightened public opinion. Volumes of his speeches have appeared from time to time, exhibiting him in a curiously kaleidoscopic aspect. Many of his remarks sound almost maniacal in their frenzy. Many have been frequently quoted, as his farewell remarks to the detachment of German troops for the seat of the Boxer rebellion in China, where he compared himself to Attila, the Hun, characterized the Chinese as «cowardly curs,» and enjoined his men to «spare nobody, make no prisoners»; the injunction to a body of recruits in Berlin to «shoot down, if need be, their own mothers and fathers, brothers and sisters, in order to fulfil their flag oath,» and many more. There is a never-ending recurrence in his speeches to the fact that his own throne was founded in bloodshed and maintained by «the bayonets of his faithful army,» a constantly reiterated assertion that his «trust is in his army.» His apologists in their commentaries advance various explanations. Probably, however, physical reasons, bodily ailments have something to do with it all.

The «zigzag course,» as Bismarck called it, pursued by the Kaiser was, of course, reflected in his choice of Chancellors after the real founder of the empire had been dismissed in disgrace. Caprivi's term was short; a thorough disbeliever in the colonizing venture, his views did not harmonize at any time with those of his master, but he obeyed the latter as his "chief commander," without questioning his orders. Prince Clovis Hohenlohe, the scion of a famous and ancient house, members of which had been leaders when the Hohenzollerns were still in obscurity, was a man of different type — used to the democratic ways of the South Germans, a kindly grandseigneur of the old school, easy-going, to be coaxed rather than bidden. When, however, the Kaiser over the head of the old gentleman had plunged into the Kiaochou adventure and almost precipitated war, Hohenlohe got out from under and made way to another man from the north, to Prince Bülow, courtly, of artistic leanings, a clever, pliable diplomat, not a statesman. He in turn met his fall by, for once, siding with the liberal Left in the Reichstag in favor of a more equable distribution of taxes in a pending bill, one making the Agrarians (and Younkers) bear a juster share of the burdens. Bülow was followed by Ernst von Bethmann-Hollweg, a well-meaning mediocrity whose will to arrive at a better understanding with Great Britain was good, but who shrank from the only means to arrive at that result.

When, in 1908, Austria-Hungary annexed Bosnia and Herzegovina, and when Russia and Serbia made warlike preparations, the Germany of those days identified herself with her neighbor and ally and unready Russia backed down. In 1910 the problem of a fairer and more liberal electoral system for Prussia played the greatest part, and the Prussian Diet (with the co-operation of the cabinet) succeeded in defeating the proposed reform. The three-class electoral system, characterized by Bismarck himself as "the worst in the world" and by means of which 85 per cent of the voting population choose but one-third of the membership of the *Landtag* (Chamber of Deputies), was retained, despite repeated pledges of the Kaiser, as king of Prussia, to abolish the iniquitous system. In the following year, Germany and Russia amicably agreed as to the Near East, especially Persia and Mesopotamia, Germany being allowed to continue her Bagdad Railway and to exploit that section commercially. During the same year another embroilment with France and England arose over Morocco. It was settled with a good deal of difficulty by France yielding up to Germany 112,000 square miles of French Kongo, in exchange for sanctioning France's protectorate over Morocco. In 1912 another memorable Reichstag election took place. The "Blue-Black Bloc" (i.e., the Junkers and the Centre party) were facing the Socialists and Liberals at the polls. The central government interfered, declaring against the latter and dubbing them enemies of the Crown. Nevertheless, the Socialists increased their number in the Reichstag by a score, to 110 seats, and their popular vote to 4,238,000. Despite this the illiberal elements in the national Parliament remained in control. They sanctioned, on the pretext of the threatening attitude of the Triple Entente, immense war preparations and a rousing special tax. The Zabern affair of 1913, originally due to trifling causes but clearly showing the preponderating influence of unchecked militarism, created a great sensation, both in and out of Germany. Throughout this whole period of 1871–1914, the country unmistakably exhibited an inner rift, occasioned by the fact that the wonderful economic progress of the nation was not accompanied by a similar political progress. The Reichstag membership was still based on the old population census of 1870, taking no account of the enormous growth of the urban population, with its overwhelming Socialist makeup, so that the outworn rural predominance of the Younker class was still retained. In the Prussian Diet (and, in a minor degree, in the other states of Germany) the misrepresentation was far worse. Practically, the ancient system amounted to a partial disfranchisement of the most progressive and best portions of the nation. The large cities, it is true, nearly all sent Socialist delegates to the Reichstag, where, however, they found themselves impotent to effect serious political reforms because of the greater number of the Younker element and its allies whose election was rendered feasible under the misrepresentative old census.

In foreign policies Germany has been, ever since the formation, first, of the *Zweibund* (Austria-Hungary and Germany) and, next, of the *Dreibund* (with Italy added), dominated by the parlous situation thus created. For Germany it has been a veritable Procrustean bed. Europe was, for many years before the actual eruption of 1914, practically divided into two hostile camps, with France, England and Russia on the one side and the *Dreibund* on the other, thus paralyzing all efforts of the nations to live in hearty concord, a thoroughly unhealthy state of things, one breeding all around distrust and hatred and rendering impossible harmony.

Of course, there have been many seeing eyes in Germany herself which discerned clearly the abnormal features in the above, features threatening perpetually the peace of the world. Bismarck, himself the creator of the *Zweibund*, and subsequently of the *Dreibund*, was by no means blind to the inherent dangers lurking in such a federation. In his literary legacy, his two volumes (with a separate appendix) of reminiscences and political reflections, published under the title of *Gedanken und Erinnerungen*, he dwells at length on the genesis of these two compacts. He discusses dispassionately their value as measures of safety and defense, and reaches the conclusion in so many plain words that neither the *Zweibund* nor the *Dreibund* were in themselves blessings, but rather temporary remedies to meet temporary exigencies. As to their weak points he had no illusions. Italy he would have liked to eliminate as a partner altogether. But above all, in his discussion of the whole problem he emphatically insists that the alliance between Germany, Austria-Hungary and Italy ought not to be looked upon as one calculated to possess permanence, giving his reasons for this opinion in unvarnished terms. It is a singular fact, nevertheless, that during this period here under discussion, beginning with the erection of a new Germanic empire and ending with the frightful war, although a period amazing so far as Germany's material progress goes, there have been but a handful of German writers doing distinguished service in elucidating public opinion as to her vital political life. Heinrich von Treitschke, who for a number of years helped to form political opinion in Germany, may be called the intellectual father of the Pan-German cast of thought and of the whole movement so denominated. Hans Delbrück, another university professor; Nietzsche with his pitiless "superman" philosophy; Franz Mehring, the Socialist expounder of scientific Socialism; Friedrich Naumann, the originator of the "Mittel Europa" idea, and Maximilian Harden, a vigorous champion of a freer political life, are nearly the whole of that little band who accompanied the iron march of those 43 years with their approval or disapproval.

Bibliography.— Arndt, F. E., 'Deutschlands Stellung in d. Weltwirtschaft' (Leipzig 1908); Bismarck, Otto v., 'Politische Reden' (Leipzig 1903. Full edition by Horst Kohl); 'Gedanken und Erinnerungen' (2 vols., Stuttgart 1896); Barker, E., 'Modern Germany' (London 1912); Dawson, J. M., 'Evolution of Modern Germany' (London 1913); Elkind, L., 'Speeches of the German Kaiser' (trans. New York 1904); Dahlmann-Waitz 'Quellenkunde d. deutsch. Geschichte' (7th ed., Leipzig 1905-06); Lair, A., 'L'Impérialisme allemand' (Paris 1902); Lamprecht, K., 'Zur jüngsten deutsch. Vergangenheit' (Berlin 1902-04); Loeb, S. J., 'German Colonial Financial System' (Public. of the American Economic Asso., 3d series, Vol. I, New York 1900); Gebhardt, Bruno, 'Deutsche Geschichte im 19 Jahrh.' (Berlin 1898-99); Liman, Paul, 'Der Kaiser, ein Charakterbild' (Berlin 1905); Klausmann, A. O., 'Reden u. Erlasse, Briefe u. Telegramme Kaiser Wilhelms II' (Leipzig 1902); Naumann, Friedrich, 'Demokratie u. Kaisertum' (Berlin 1906); Schierbrand, Wolf von, 'Germany, the Welding of a World Power' (New York 1902); id., 'The Kaiser's Speeches' (New York 1903); Sombart, Werner, 'Sozialismus und soziale Bewegungen im 19 Jahrh.' (Jena 1901); Taylor, W. G., 'Bismarck, or the Typical German' (Amer. Hist. Ass. Papers, Vol. V); Treitschke, H. von, 'Reichstagreden'; 'Politik' (ed. Max Cornicelius, Leipzig 1899-1901); Ziegler, T., 'Die geistigen u. sozialen Strömungen d. 19 Jahrh.' (Berlin 1899).

WOLF VON SCHIERBRAND.

4. PARTIES AND PARTY POLITICS. The popular organ of government in the German Empire is the Reichstag (Diet). According to the constitution it is supposed to be a co-ordinate factor with the Bundesrat (Federal Council) in Imperial legislation. However, since the latter body sanctions all laws, and since by practice almost all the important legislation starts in the Bundesrat, and since above all the chancellor and the heads of the executive departments are not responsible to the Reichstag but to the Kaiser, the function of the Reichstag is in fact not more than to control the government as carried on by the sovereigns of the different states under the very prominent leadership of the king of Prussia. From this situation it can easily be seen that party politics do not play the same important part as in countries where the head of the government is in general the leader of the party in power, as in England or in the United States.

Franchise and Constituencies.— The franchise for the Reichstag is granted to all male citizens of the age of 25. Disfranchised are persons under guardianship, those in a state of bankruptcy, and those who have received alms from public funds during the year preceding the election. Persons active in naval or military service are suspended during their period of active service. The qualifications for candidates are the same as for voters, except that the former must have been citizens of any of the federal states for at least one year. Thus we see that practically every male citizen has one vote in deciding the composition of the popular legislative branch of government in Germany.

However the arrangement of constituencies is such that a large number of the people have proportionally two or more votes. According to the Election Law a population of 100,000 was to elect one representative. Each state was given at least one representative regardless of population. This law contains also the provision that a rearrangement of the constituencies was to be made according to the increase or decrease of the population. Yet this redistribution has never taken place in spite of the enormous shifting from the rural districts to the cities as a consequence of the industrial and commercial development of Germany. To-day the deputies of the largest constituencies represent several hundred thousand, while those of the smallest voting districts represent only from 15,000 to 30,000 people. In case of a strictly arithmetical redistribution the Social-Democrats would have more than twice the number of the Conservative groups, having behind them 4,250,000 voters against the 1,933,000 of the Conservatives, while to-day the Socialists have 110 seats and the Conservatives 74. But the German government looks at the representation in the Reichstag as that of interest rather than that of numbers. It was afraid that otherwise the agricultural interests would be *drowned*. The European War has fully justified the attitude of the government. Without the good condition of its agriculture, which to a very great extent was made possible through the special care and protection of the government, Germany would in spite of military victory have been forced to surrender unconditionally to her enemies.

The Personnel of the Reichstag.— The personnel of the Reichstag compares in general favorably with that of other popular legislative bodies. Men from all walks of life are represented among the 397 members of the Reichstag; 88 members are engaged in agriculture, 5 in industry, 17 in commerce, 2 in trade, 3 are unskilled laborers, 13 live on their own income, and the remainder, 250, are in professional life. Of these latter, 58 are journalists and writers, 20 are Catholic priests, 1 is a Protestant minister, 22 are professors and teachers, 8 are physicians and apothecaries, 39 are lawyers, 24 are judges, 21 are state officers, 7 are communal officers, and 50 are professional employees. Of the deputies, 206 had an academic graduate training, 80 of the members were officers of the reserve. Most of the deputies had some political training in city or local government before their election to the Reichstag. More than half of the members of the present Reichstag were re-elected or had been members during a previous legislative period.

Parties and Party Principles.— The numerous parties of the Reichstag may be grouped into four great parties: Conservatives, Clericals, Liberals, and Social-Democrats. From the location of their seats, as viewed from the speaker's platform, they are often referred to as the Right, the Centre, the Left, and the Extreme Left respectively. The basic philosophical principle of the conservative parties is authority from above. Throne and altar, i.e., monarchy by the grace of God and the established Church, are, according to their conception, the two strong pillars of the state. They are strongly opposed to the introduction of the democratic form of government. The public schools should be supervised by the state. Part of the Conservatives, sometimes the majority, have believed in special legislation against the Jews, in whom they feared the absolute representatives of commerce and industry, of the metropolitan press and of the exchange, the powerful enemies of the interests which the Conservatives promote. In regard to social reform the Conservatives have enthusiastically supported the so-called state socialism inaugurated by Bismarck, the most important results of which were the splendid compulsory insurance laws of the '80s. They regard social reform as a voluntary but necessary gift of a state the government of which is based on the Christian principle of love and care for the poor and unprotected people.

The Conservatives are at present split into the High-Conservatives (or Conservatives proper), the Free-Conservatives (or Imperial Party), the Economic Union, and the Christian Socialists. While the High-Conservatives have frequently disagreed with progressive policies of the government, the Free-Conservatives are the government party par excellence. They separated from the High-Conservatives in the '70s in order to support Bismarck. The Economic Union emphasizes the protection of the middle class, and the Christian-Socialists emphasize social reform through the government in the Christian spirit. At one time there existed the Anti-Semites and the Farmers' Union or Agrarians as distinct conservative parties, and their spirit is still more or less in existence among the Conservatives. The Agrarians have extended their influence over the Clericals and partly over the National-Liberals.

Fundamentally the Clericals are conservative. Their main principle is the upholding of the interest of the Catholic minority in Germany. In this policy rests their strength. For this reason they count almost all the Catholics among their followers, rich and poor, employers and employees, industrial working men, and above all, the peasants. Naturally in order to hold this heterogeneous mass of voters together they must combine conservative and democratic principles. This they have successfully done and have so far always been able to keep their hold on the Catholic population of Germany. In regard to school policy and social reform they generally agree with the Conservatives. The organization and leadership of the party is splendid and has a great deal to do with its steady success.

The philosophical principle underlying liberalism is individual liberty. The Liberals are, so to speak, the Protestants in the field of politics. The danger of liberalism is weakness in discipline and organization, obstinacy in placing a certain dogma above all other beliefs with the result that the party is easily split into many small inefficient groups. This has been the fate of the Liberals in Germany until recently. Several times they have been divided into Progressives, Free-Thinking-Union, South-German People's Party, Democratic Union, etc. At present, they form two units: the National-Liberals and the Liberals proper or Radicals.

The National-Liberals are in many respects more conservative than liberal. They are a middle party of compromises. They are the strongest believers in nationalism and imperialism, and, as a whole, represent the spirit of modern Germany better than any other party.

The Radical-Liberals advocate especially an arithmetical redistribution of the constituencies for the Reichstag, the introduction of universal manhood suffrage in the several states, above all, in Prussia, abolition of any special privileges of the nobility, extension of the power of the Reichstag, introduction of parliamentary government, a public school free from the supervision of the church, substitution of indirect taxes by direct taxes.

The aim of the Social-Democrats is twofold. In the economic field they work for complete socialization of all means of production and a more just valuation of labor. In the political field they want to establish a direct true democracy. Therefore they advocate: initiative, referendum, recall, universal suffrage with proportional representation, a free church, free public schools including universities, free legal and medical help, high income and inheritance tax, and abolition of all indirect taxation. The German Social-Democrats, like the socialists in all countries, are internally divided into two groups, the Revisionists who wish to participate in all constructive legislation tending to the socialistic goal, and the Radicals, who believe in the principle "all or nothing." Up to the European war, however, the differences of opinion were fought out within the party and in the end the party always voted as a unit according to majority rule. During the war a small party of Internationalists have separated from the large party and with this the solidarity of Social-Democracy has, for the first time, been broken.

Besides these four big groups there are a few deputies in the Reichstag who protest against the incorporation of certain races in the empire. The strongest of these, the Poles, vote in almost all other questions with their co-religionists, the Clericals. The same is true with the Alsatians. The one Danish representative votes usually with the Liberals. The Guelph party, protesting against the annexation of Hanover by Germany, has gone out of existence since the marriage of the Duke of Brunswick, heir to the throne of Hanover, to the daughter of Kaiser Wilhelm the Second, and his acquiescence in the present situation.

In regard to class interests the different parties show, roughly speaking, the following representation:

Conservatives — Agriculture, crafts, shopkeepers, higher and middle rank officials, orthodox Protestant Church.

Clericals — Above all the interests of Catholicism from Catholic nobility to peasantry.

Liberals — The right wing, or National Liberals: large industrial and commercial interests, science; the left wing: commerce, crafts, science, communal officers, middle and lower rank officials.

Social-Democrats — Workingmen.

The tariff policy of the different parties is consequently as follows:

Conservatives — High protective tariff, especially for agricultural products.

Clericals — Protective tariff.

National Liberals — Protective tariff, especially for commerce and industry

Liberals — Free trade or very low protection for industry and commerce.

Social-Democrats — Free trade.

Outline of Party History.— 1871–1878. During this period the National Liberals were by far the strongest party and Bismarck relied on their support and that of the Free-Conservatives. These parties rendered the same service to the new German Empire which the Federalists rendered to the young republic of the United States. With their assistance the organization of the government was established on a firm basis. This period is filled with the deplorable conflict between the state and the Catholic Church, the so-called Kulturkampf. Finally, the government had to compromise with the rapidly growing Clerical party. The National-Liberals were dropped as "factio non grata," because they opposed the special legislation of persecution proposed by Bismarck against the growing Social-Democratic party, and the creation of financial independence of the empire without political responsibility to the Reichstag.

1878–1887. In the following decade Bismarck depended for the support of his bills mainly on the Conservatives and Clericals. In the year 1879 Bismarck, with the help of the Conservatives and Clericals, changed the tariff policy from free trade to protection. The National-Liberals split over this issue.

1887–1890. In the year 1887 the Reichstag was dissolved because the government could not find a majority for its demands of a strengthening of the army, necessitated by the threatening "revanche" of France under the leadership of General Boulanger. The result of the election of 1887 was the victory of the government which found a working majority in the Conservatives and the National-Liberals, a union known in German parliamentary history as the Cartell.

1890–1907. In the election of 1890 the Cartell majority broke down and the government had to make further concessions to the Clericals in order to win their support. Until 1907 the Imperial government relied in the Reichstag on the Conservative Clerical Union or Bloc.

1907–1908. But the Clericals were very unreliable and demanded special privileges in return for their co-operation with the government. When for this reason they refused to grant the necessary money to put down the Herero rebellion in German Southwest Africa, the government dissolved the Reichstag and appealed to the people. The election brought the government a majority of a Conservative-Liberal combination. However, this unnatural alliance was dissolved in the very next year because the two parties could not agree on part of the financial reform of the Empire.

Since 1908. Therefore Bülow resigned as Chancellor and Bethmann-Hollweg returned to the old *bloc* of Conservatives and Clericals. The situation is now such that the National Liberals hold the balance of power and can throw it either to the Conservative-Clerical or the Liberal-Socialist group.

The following table shows the party movement in the Reichstag from 1871 to the 1912 legislative period:

PARTIES	1871	1874	1877	1878	1881	1884	1887	1890	1893	1898	1903	1907	1912
Conservatives	54	21	40	59	50	78	80	73	72	56	52	60	43
Free Conservatives	38	33	38	56	28	28	41	20	28	23	20	25	15
Anti-Semitics, Agrarians							1	5	16	24	18	27	14
Center (Clericals)	58	91	93	93	98	99	98	106	96	102	100	104	93
Poles, Alsace-Lorraine representatives, Guelphs, Bavarian Farmers' Union	21	33	28	35	43	42	32	37	37	33	31	28	30
National Liberals and Allies	150	152	127	98	45	50	99	42	53	47	50	56	44
Liberals of the Left	47	50	48	34	114	74	32	76	48	50	36	50	45
Social-Democrats	1	19	12	9	12	24	11	35	44	56	81	43	110
Independents	28	8	11	13	7	2	3	3	3	6	9	4	3

Bibliography.— Mahler, K., 'Die Programme der pol. Parteien in Deutschland' (Leipzig 1911); Lowell, A. L., 'Government and Parties in Continental Europe' (2 vols., Boston 1896); Ogg, F. A., 'The Governments of Europe' (New York 1912); Krüger, F. K., 'Government and Politics of the German Empire' (Yonkers-on-Hudson 1915); Bülow, B. von, 'Imperial Germany' (Pt. II, New York 1914).

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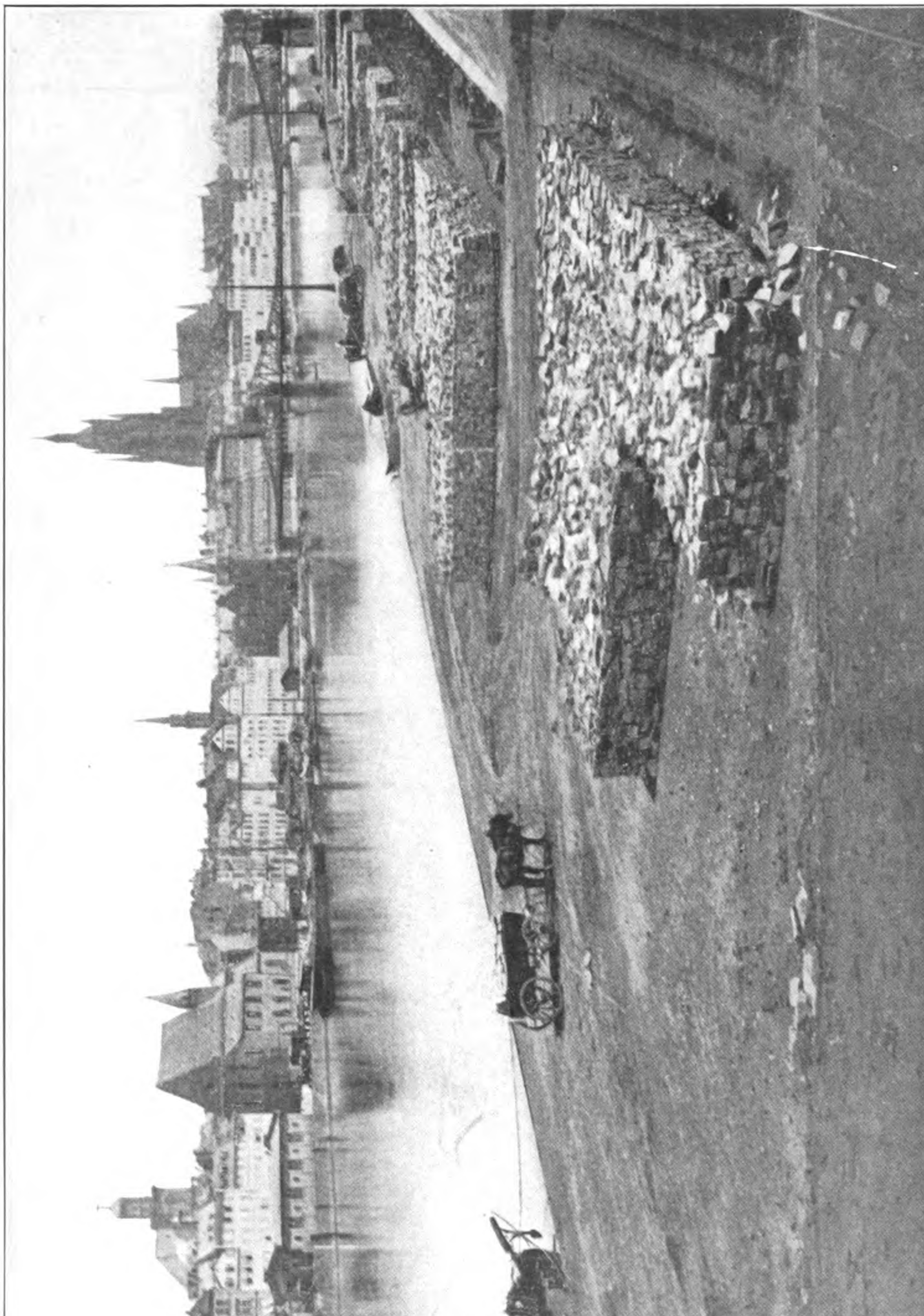
5. THE GOVERNMENT. Generally speaking, the predecessor of the present German Empire was the Holy Roman Empire of the German Nation whose origin may be dated back to the year 800, when Charlemagne, ruler of the Germanic Francs, assumed the Imperial crown of the old Roman Empire, thus reviving the ancient idea of an "imperium mundi." But in constant struggles with the papacy, which as the "sacerdotium mundi" considered itself the master over the imperium and with the territorial rulers and lords within the empire, the central authority was steadily weakened so that at the end of the Thirty Years' War (1648) the power of the emperor was merely a shadow; the real power being in the hands of the territorial rulers, secular and ecclesiastic, of whom there existed about 300. The German



The City of Frankfort

1 Brandenburg Gate, Berlin

2 The Royal Museum, Berlin

of these times had no national fatherland; his fatherland was the small state in which he was born and reared. A Prussian regarded a Bavarian as a foreigner, a Bavarian a citizen of Würtemberg, etc. As a matter of fact, when in the year 1805 the last German emperor abdicated, the thousand year old state was, as Voltaire had expressed it, neither Holy nor Roman nor an empire. It had given up its intimate connection with the Catholic Church, the Italian parts of it had separated from it, and the sovereign empire had changed into a confederation of numerous sovereign states. It was not difficult for the genius of Napoleon I at the head of a regenerated and united national France, to destroy this skeleton. With one sweep the revolutionary contemptor of tradition decreased the number of the German states from ca. 300 to some 30, thus unknowingly rendering a valuable service to the future unification of Germany. After the complete defeat of the strongest German state, (1806–07), Prussia, and its reduction to about half of its territory, almost all Germany was at the mercy of the French victor who treated it contemptuously as his vassal. But during this time of extreme humiliation the fundamental strength of the Prussian state and the splendid spirit of its citizens became manifest. In a surprisingly short time, a thorough regeneration took place under the leadership of Stein. Hardenberg, Scharnhorst and many other prominent men. The purpose of these reforms was to increase in the citizens a feeling of responsibility in the affairs of the government by direct participation in them. The reforms began with the revival of self-government in the cities, as it is still essentially in existence at the present time. It was Stein's intention gradually to extend this participation of the citizens in state government and finally to unite the different states in a federation with one head and a national representative legislature. However his dreams were not realized. The southern states of Germany adopted constitutions between 1818 and 1820, the central and some smaller northern states followed in the 30's, but Prussia and Austria, the two leading German states, had to be forced to introduce constitutional government through the revolution of 1848. At the same time the hope for a real national German state was for the time lost when, at the Congress of Vienna (1815), an unsatisfactory, loose confederation of the German states was formed under the name «Der Deutsche Bund.» But the longing for a powerful national German state was strong among the German people, and several attempts were made to bring it about. The most notable of these was the German Parliament at Frankfort-on-Main 1848, chosen by universal suffrage for the purpose of drawing up a constitution and electing a German emperor. This attempt, like all the others, was unsuccessful. An empire with two jealous rivals, Austria and Prussia, fighting for the leadership, was impossible. Bismarck's political genius clearly recognized this. Only «with blood and iron and not by orations» could the new empire be established. The rivalry between Austria and Prussia led to the so-called German War in the year 1866. As a result of it Austria had to give up her connection with the rest of the German states, a federation of the northern German states under the leadership of Prussia was formed and the three southern German states entered into an alliance with the North-German Federation (the Norddeutsche Bund).

The alliance of North and South Germany was tested in the Franco-German War of 1870–71. The outcome of the brilliant victory of united Germany over France was the establishment of the national German Empire, 1 Jan. 1871. (The date of the revised constitution is 16 April 1871).

Nature of the German Empire.— The German Empire is a federation of 25 states, of which 23 are monarchies and two republics. In joining the Union the states have voluntarily given up their sovereignty and received a share in the sovereignty of the empire. Sovereignty rests with the Bundesrat, since it is this body, as we shall see, that has the final saying in regard to all laws including the supreme law of the land — the constitution. The Bundesrat is the representative body of the princes and the senates of the 25 states. Therefore, strictly speaking, the German Empire is an aristocratic polyarchy. However, the power of the Kaiser as Prussian member of the Bundesrat and as head of the imperial administration, is so preponderating that from the viewpoint of practical politics the German Empire is a monarchy, limited by the representation of the people in the Reichstag and by that of the states in the Bundesrat, or in other words, it is a constitutional monarchy limited federatively.

The Organization of the Government: The Kaiser.— The «German Kaiser» — this is the proper title — is always the King of Prussia. Prussian law determines the succession. It is accordingly a hereditary office. Most of the power of the Kaiser in the empire is derived from his position as the head of the strongest and most privileged state in the Union. As such he controls about one-third of the votes in the Bundesrat, and through his prestige he has an almost controlling influence over this important organ of legislation. He has a veto on all constitutional amendments and on changes of existing taxes and custom duties. He appoints the members of the important committees in the Bundesrat for the army, the navy and fortresses. The legislative bodies are convened, opened, adjourned and dissolved by the Kaiser. The executive functions of the Kaiser are of the greatest importance. He appoints and dismisses the Chancellor and all imperial officers, and thus controls the administration of the empire. International representation of the country lies entirely in his hands. With unessential limitations in regard to Bavaria and Würtemberg, mentioned below, he is commander-in-chief of the army and navy in times of war and peace, and may declare martial law in any part of Germany. He appoints and removes the governor of the imperial territory Alsace-Lorraine and thus controls its votes in the Bundesrat. Governmental authority in the protectorates is also, by special law, vested in the Kaiser. Like all other rulers he has an extensive pardoning power. The Kaiser «can do no wrong.» The responsibility for his public acts is assumed by the Chancellor. As German Kaiser, he receives no financial remuneration except a comparatively small amount for purposes of state representation.

The Bundesrat.— The Bundesrat, or Federal Council, represents the federal principle. Its members are instructed delegates of the sovereigns of the several states, i.e., of the princes of the 22 monarchies and of the senates of the three republics. The members of the Bundesrat are responsible to their respective sovereigns for their votes in this body. The votes are not counted individually but as units for each state. Unlike the Senate of the United States, state representation in the Bundesrat is unequal. However, it is not in proportion to the territory or population, for in such a case Prussia would always have a majority of three-fifths and the purpose of the Bundesrat as a co-operative federal organ would be destroyed. Therefore a somewhat artificial distribution of votes, based upon historical precedent, was made and Prussia was given 17 votes (through control of the one vote of the principality of Waldeck and the three of Alsace-Lorraine it really has 21), Bavaria 6, Würtemberg and Saxony, 4 each, Baden and Hesse, 3 each, Mecklenburg-Schwerin and Brunswick, 2 each, and the remaining 17 states 1 vote each. The presiding officer of the Bundesrat is a Prussian member, ordinarily the Chancellor. The business of the Bundesrat has become so extensive that in practice it is now a permanent body, although, as said before, not in theory.

The Bundesrat is above all a legislative organ. Laws may, and are usually, first discussed in this body and must always be sanctioned by it. As an administrative organ, the Bundesrat takes action upon the general administrative provisions and arrangements necessary for the execution of the imperial laws. Like the Senate of the United States, it has the right to recommend and elect some higher administrative officers. A great deal of ordinance power is also delegated to the Bundesrat. In the judicial field the Bundesrat acts frequently as an imperial administrative court. Upon complaint, the Bundesrat may force a state to render justice to an individual. In a very restricted sense the interpretation of the constitution is left to the Bundesrat. At the request of one of the parties, the Bundesrat decides disputes in public law between several states and constitutional disputes within the state.

The Reichstag.— The Reichstag is the representative body of all the German people. Its 397 members are chosen by universal male suffrage, the voting being secret and direct. Every German man 25 years old has a vote and is eligible to the Reichstag. The disqualifications are essentially the same as in the United States. An absolute majority is necessary for election. If no candidate has such a majority a second election between the two highest candidates takes place within 14 days after the general election. Elections are protected by special provisions in the Criminal Code of the empire. The Reichstag is judge of the correctness of the elections. Its organizations and proceedings with the exception of the selection of committees are almost the same as in the United States. The committees, in which as a matter of fact most of the business is done, just as in the United States, are elected in the following way: At the beginning of the legislative period the members are divided by lot into seven equal sections. Each section elects an equal number of men to each committee. The deputies enjoy the usual parliamentary immunities. Since 1906 they reserve a small annual remuneration of 3,000 marks and free use of the railroad. Twenty marks are deducted for absence from a meeting. The meetings are public, while those of the Bundesrat are secret. The legislative period is five years, but may be shortened by a dissolution of the body through the Bundesrat with the consent of the Kaiser. A new election must then take place shortly afterward. The Reichstag must be convened at least once a year.

The Reichstag participates in legislation with the Bundesrat and may introduce bills, just as the Bundesrat. Its approval is necessary for imperial loans, certain ordinances and treaties, if these affect the citizens directly. The Reichstag may as a body petition the Chancellor and express its disapproval of his policy by a vote of want of confidence, which, however, in Germany has no effect on the position of the Chancellor. The representatives of the government and the Bundesrat have at any time the right to appear before the Reichstag and advocate and defend the bills of the Bundesrat. They have, however, no vote. See article PARTIES AND PARTY POLITICS.

The Chancellor and the Administrative Officers.— The supreme and only officer created by the constitution is the Chancellor. He is the chairman of the Bundesrat and head of the whole imperial administration. By countersigning all imperial documents he assumes the responsibility for them. He is appointed and removed by the Kaiser, neither Reichstag nor Bundesrat can force his resignation. The kind of responsibility is not fixed by the constitution or by law. At the head of the different branches of the administration are secretaries of state who are subordinated to the Chancellor and who remain in office only as long as they are in harmony with the policy of the Chancellor. At present there exist the following supreme offices presided over by secretaries: Interior, treasury, justice, post, foreign affairs, army, navy. These secretaries may also countersign the acts of the Kaiser. The leading position of Prussia in the German Federation requires that the Chancellor is at the same time the Prime Minister of Prussia, although this is not laid down in the constitution. Twice the two positions were in different hands, but both times the experiment was a failure and was soon given up. Under the heads of departments a host of civil service officers serve who are, according to their training, salary and social position, divided into three classes. They are subject to a special law, hold their office during life or good behavior, and receive a pension in case of disability or old age.

The Functions of Government: Legislation.— Bills, as said before, may be proposed either by the Reichstag or the Bundesrat. The majority, however, are prepared in the Prussian ministries and introduced in the Bundesrat by Prussia. Here they go through the customary readings and committees. A bill is passed by a majority vote, in case of a tie Prussia's vote decides the matter. No state is allowed to vote on matters in regard to which it enjoys special privileges. Constitutional amendments are treated just like other bills, except that 14 votes are sufficient to kill them, which gives Prussia an absolute veto in this respect. The bill, when passed, is then sent to the Reichstag. Here it is usually given to a committee after the first reading, and from there is reported to the Reichstag, and after two more readings passed, rejected or passed with amendments. If passed, it goes to the Bundesrat for final approval. The sanctioned bill is then examined by the Kaiser as to the constitutionality of its form (but not its contents), promulgated and published with the countersignature of the Chancellor in the official *Imperial Gazette.* Whenever it is later on found out that imperial and state law conflict, the rule is, that imperial law takes precedence over state law.

Administration.—While in the United States the principle of relationship between the Union and the States in regard to legislation and administration is, that laws made by the Union are executed by federal officers and laws made by the states are executed by state officers, in Germany the general rule is that imperial laws are carried out by state officials. The empire reserves to itself merely the right of supervision, so that the laws are carried out in the spirit in which they were made. If a state refuses to carry out an imperial law it can be forced to do so by the Kaiser upon a decision by the Bundesrat. This process, which so far has never been necessary, is called «Federal Execution.» Certain fields of imperial legislation are, however, directly administered by federal officers, such as matters pertaining to diplomatic and consular, army, naval, colonial, certain financial, post and telegraph affairs. And finally there are a few cases, in which only a general principle is laid down by imperial legislation, while the details of legislation and the whole administration are left to the several states.

The Empire and the States.— The unequal position of the individual states in the federal representative organ, the Bundesrat, and the relation of imperial legislation and state administration, as well as the special position of Prussia have been described previously. There remain to be mentioned a few special privileges of certain states. These privileges can be abolished only with the consent of the respective states. Thus Bavaria has privileges in regard to railroad regulation, military matters, post and telegraphs. Bavaria, Würtemberg and Baden have the right of taxation of wine and beer, produced in their territory. Würtemberg has some special privileges in regard to her post and telegraph service and in regard to the organization of her army. Hamburg and Bremen enjoy the privilege of a small freeport, i.e., a territory exempt from the customs duties of the empire.

All matters not regulated by the constitution of the empire or by imperial law are left to the legislation of the states. Among these are: A large field of taxation, laws relative to church and schools, agriculture, forestry, mining, hunting, water and road rights.

The Organization of the States.— The three republics of the Federation are the so-called Hanse Cities — Hamburg, Bremen and Lübeck. Their organs of government are a Senate elected by the lower House and presided over by a mayor and a lower House, the Bürgerschaft, elected by universal suffrage in Hamburg and by a property class system in the other two city-states. The two bodies are co-ordinated factors in legislation. The administration is in the hands of members of the Senate, the mayor being the head of the administration. In the two grand-duchies of Mecklenburg the monarchs are limited by a representation of two estates. All the other states (four kingdoms, four grand-duchies, five duchies, seven principalities) are modern constitutional monarchies. The rulers are limited in the exercise of their governmental rights by legislative chambers, in the larger states, after the English model by two chambers, in the smaller states by one. The Upper House is composed of hereditary members of the nobility and prominent citizens appointed by the sovereigns. The suffrage for the lower chambers differs widely. Prussia has still a class system of voting based on the amount of direct taxes, giving the wealthy people a preponderating influence in the affairs of the state, while Würtemberg has even partly introduced proportional representation. It is to be expected that soon the suffrage for the Reichstag will be introduced in all states for the election of the lower Houses.

The local government of the different states differs widely. There are even fundamental differences within the larger states. The reason for this somewhat strange situation is found in the historical development of the different parts of Germany. In general, the western and southern parts of Germany which have been strongly under Napoleonic influence have developed and preserved a more bureaucratic administration, while the central German parts under the influence of Stein-Hardenberg have introduced the English and old Germanic system of self-government, and in the eastern thinly populated parts, where landlordism has been so long in existence, some remnants of the old feudal system are still to be found. The smaller states have usually two divisions of local government, the larger ones three. It is impossible to discuss even in outline form the many differences of local government in the several states of the empire. We can only state very briefly the organization of local government in the central and eastern parts of Prussia. The largest unit of local government is the province, of which Prussia has 12. Its local affairs are partly administered by state and partly by unpaid honorary lay-officers, prominent, public-spirited inhabitants of the province. It has a large legislative assembly elected by the assemblies of the circles, a smaller executive council and an administrative head. The next subdivision, the district, is purely a division of state government. A district contains several circles, which are organized in analogy to the provinces. The circle is composed of county and city communities. The city has the most perfect self-government of all the divisions of local government. Its organs are a large assembly, elected by a suffrage somewhat similar to that for the lower state legislature (which, with modifications, is the model for all elections in local government), a small council, elected by the assembly, and one or two mayors, usually elected by the assembly alone or by both bodies for a period of 6 or 12 years, or sometimes for life. The members of the council are partly unpaid honorary laymen, partly highly trained and well paid administrative officers. Country communities are organized on a similar basis. Besides these units of local government, there still exist a number of manors, in which the lord of the manor has all the rights and duties of government.

Alsace-Lorraine.— The present legal status of the imperial territory Alsace-Lorraine dates back to an imperial statute of 1911. At the head of the government is a governor who is appointed and removed by the Kaiser. The governor, indirectly, therefore, the Kaiser, instructs the three representatives of Alsace-Lorraine in the Bundesrat. Their votes are not counted for Prussia unless this state has a majority without such votes. Neither are they counted when an amendment to the Constitution is proposed. The legislative department consists of two houses with equal rights in lawmaking. Of the members of the upper House one-half are nominated by the Bundesrat and appointed by the Kaiser; the rest are members either by virtue of holding certain offices or by being elected as representatives of municipal, industrial, and commercial bodies. The franchise for the lower House is the same as for the Reichstag. The legislative period for both Houses is five years. The Kaiser has an absolute veto in regard to laws made by the legislature of Alsace-Lorraine. For the purpose of local government the territory is divided into three districts, and these are in turn subdivided into circles and communes. The government of Alsace-Lorraine has undergone five changes since the territory was acquired by Germany in 1871, each change giving the territory a larger amount of self-government.

Bibliography.— Burgess, J. W., ‘Political Science and Comparative Constitutional Laws’ (2 vols., Boston 1893); Howard, B. E., ‘The German Empire’ (New York 1906. At the end of the book an English translation of the Constitution); James, H. G., ‘Principles of Prussian Administration’ (New York 1913); Krüger, F. K., ‘Government and Politics of the German Empire’ (Yonkers-on-Hudson 1915. Contains a systematic bibliography); Lowell, A. L., ‘Government and Parties in Continental Europe’ (2 vols., Boston 1896); Ogg, F. A., ‘The Governments of Europe’ (New York 1912); Priest, G. M., ‘Germany since 1740’ (Boston 1915).

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6. THE JUDICIARY. The system of law and the organization of justice of the German Empire differs in every respect from that of the United States of America. The law of the United States is the Anglo-Saxon common law, based upon precedence; the law of Germany is codified, laying down principles of justice applicable to definite legal disputes and crimes. While in the United States all legal cases are settled in the same courts, German legal conception discriminates between two distinct branches: Ordinary law (civil and criminal law) and administrative law, which are administered in two entirely different types of courts. Furthermore, while the United States recognizes two separate sets of courts, the Federal and the State courts, between which jurisdiction is divided, the German system of ordinary law knows only one law, the imperial law, which is administered by state courts alone with final appeal in most cases to the only imperial court, the Reichsgericht in Leipzig, Saxony.

Organization of Ordinary Courts.— The organization of ordinary courts is laid down by an imperial law of 1879. The lowest ordinary court is the Amtsgericht (County Court). The next highest court is the Landgericht (District Court). Superior to this court is the Oberlandesgericht (Provincial or State Court). Some of the smaller states have one Oberlandesgericht in common. A few of the largest states with several Oberlandesgerichte have designated one of them as the Supreme State Court, to which certain cases are delegated, which otherwise go to the Supreme Court of appeal, the Reichsgericht or Imperial Court. Besides these regular courts of ordinary law there are a few special courts, such as the Kammern fuer Handelssachen (Commercial Courts) in connection with the larger Landgerichte, the military courts, colonial courts and imperial consular courts, in a very few half-civilized countries.

At the head of the Amtsgericht is one single judge who in criminal cases is assisted by two laymen as jurors. The Landgericht has three divisions. The decision of civil cases rests with three judges. Minor criminal cases are tried by the Strafkammern or Chambers for Criminal Cases, consisting of five judges. Almost all other cases go to the division called Schwurgerichte or Courts of Jury. These are composed of three judges and 12 lay jurors. The Oberlandesgericht and the Reichsgericht are divided into senate, or departments for civil and departments for criminal cases. The departments of the Oberlandesgerichte are composed of five judges, those of the Reichsgericht of seven.

Civil and Criminal Codes.— The excellent Civil Code of the German Empire went into effect 1 Jan. 1900, after a most careful preparation of 23 years. It is generally recognized by foreign jurists as a masterwork of jurisprudence. The code is divided into five parts: General principles, law of obligations, law of things, family law, and law of inheritance. The Criminal Code of the empire dates back to 31 May 1870. It is in many respects antiquated, and preparations for a new criminal code are under way. Besides the Criminal Code there are many individual imperial laws which provide punishment for misdemeanors and crimes, such as the Press Law, the Espionage Law, the Pure Food Law, the Trade Law, etc. Punishment for violation of police regulations, mining, fishing, hunting, and forestry laws are left to the individual states.

Procedure in Civil and Criminal Law.— In litigation in private law, involving a sum not exceeding 600 marks (about $150), the Amtsgericht is the first court. In all other cases suits start in the Landgericht. The course of appeal is from the Amtsgericht to the Landgericht, from the Landgericht to the Oberlandesgericht, and from the Oberlandesgericht to the Reichsgericht for revision. Minor cases in criminal law are also settled first in the Amtsgericht. All serious criminal cases, such as are punishable up to a maximum of five years of penal confinement, repetition of misdemeanors, theft and concealing of stolen goods, are tried by the Strafkammer. All other criminal cases are under the jurisdiction of the Schwurgerichte, except cases of high treason and espionage which are decided by the Reichsgericht alone. Appeal in criminal cases is only permitted from the Amtsgericht to the Strafkammer. The decisions of the other courts are only subject to revision by the Oberlandesgericht and the Reichsgericht.

Judicial Officers.— The judges of the German courts are appointed by the sovereigns of the individual states, with the exception of the judges of the Reichsgericht who are appointed by the Kaiser with the consent of the Bundesrat and must have passed the 35th year. No judge can be removed or transferred for other than legal reasons and without a legal process. The training of judges is the same all over the German Empire. After a post-graduate course of at least three years in the department of jurisprudence in a German university they must pass a rigid examination. They further receive practical training of three or four years in the different legal offices and after passing a second examination of a more practical nature they are appointed judges whenever a vacancy occurs. The jurors are lay judges without remuneration and decide only the question of guilt or innocence of the accused. A public prosecutor is connected with each court who, in the case of the Amtsgericht, is a civil service officer of the middle rank, in all other cases a judicial officer of the same training as the judges. With the exception of a few cases in which the interest of the state is not directly concerned the public prosecutor must prosecute any case brought to his attention. Attorneys at law (and in almost all states also notaries) have the same legal training as judges. In civil cases they are assigned to a certain court, in criminal cases they can practise at any court. The clerks of the courts are civil service officers who are trained in the principles of law.

Administrative Law.— Administrative law fixes the details of the organization of the government, determines the competence of the administrative authorities and gives the individual redress in case his rights are violated. This type of law is administered by special administrative courts of the different states. These courts are at the same time purely administrative bodies in local government. In Prussia small executive committees of the circle and the province, composed partly of lay members, partly of professional administrative officers, serve as administrative courts of first and second instance. In addition, Prussia has established a supreme administrative court, the Oberverwaltungsgericht in Berlin. This is a purely judicial body. No member can be less than 30 years of age. Half of them must be judges, half of them qualified for the higher positions in the administrative service. They cannot be removed except for legal reasons. The empire as such has very little administration of its own and consequently there exists very little imperial administrative law with few imperial administrative courts. Some of them are the Railroad Commission, the Supreme Maritime Office, the Imperial Insurance Office, the Patent Office, etc.

Question of Legality and Constitutionality.— The question whether or not the courts have a right to test the legality of laws and ordinances is disputed. The majority of writers concede the right to the courts arguing that the privilege of applying the law involves the duty of investigating its legal form. In Prussia, however, a clause of the Constitution (Art. 106) expressly forbids the courts to test the legality of properly proclaimed laws or royal ordinances. In regard to the question of declaring laws unconstitutional the general opinion is that the German courts have no such right. This is also the opinion of the Reichsgericht (in a decision of 26 March 1901). German jurisprudence considers lawmaking as an act of the sovereign who is superior to the servants of the sovereign, i.e., judges or administrators. It is true that this situation leaves the whole field of constitutional law with little legal protection, for the institution of impeachment has not yet been developed. The principle of ministerial responsibility, to be sure, has been laid down in all constitutions of the empire. Some of the individual states have also laid down the procedure of impeachment. In the empire itself and in the leading state, Prussia, nothing but the principle is stated. However, in Prussia, and in some other states, a superior officer can submit the question to the Oberverwaltungsgericht whether an indicted official under his authority, against whom civil or criminal charges for acts done in his official capacity have been preferred, has violated his duty or not. If this question is decided in the affirmative, the case is tried in the ordinary courts.

Conflicts of Competence.— It can easily be seen that conflicts might arise as to which set of courts, administrative or ordinary, a case should go. The empire leaves it to the individual states to settle these conflicts. Prussia and some other states have established special Courts of Competence (Kompetenzgerichtshöfe) composed of higher administrative and judicial officers. They decide to which court a case should go if both, administrative and ordinary courts, claim or reject a case.

Non-contentious Jurisdiction.— In addition to the ordinary and the administrative law the so-called non-contentious jurisdiction must be mentioned. This is the administrative assistance of courts or judicial officers in the creation of private rights. It is usually performed by the Amtsgerichte. The subjects of non-contentious jurisdiction are: Registration of land titles, guardianship, registration of marriage contracts and commercial firms, probate matters, and in some states authentication of documents.

Bibliography.— Borchard, E. M., 'Guide to the Law of Germany' (Washington 1912); Howard, B. E., 'The German Empire' (New York 1906); Krüger, F. K., 'Government and Politics of the German Empire' (Yonkers-on-Hudson 1915); Schuster, E. J., 'The Principles of the German Civil Law' (Oxford 1907).

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7. HISTORY OF THE GERMAN LANGUAGE. The Modern German Language, as written, spoken on the stage and also, with certain provincial variations in the ordinary intercourse of the educated classes of the German Empire and of parts of Austria and Switzerland, is a literary language which has arisen by a process of selection and refinement from the popular dialects formerly used in their respective territories and preserved even now in the natural speech of the uneducated and, to some extent, in dialectic literature. At the beginning of historical tradition these dialects, in their entirety, had certain important characteristics which justify their classification under the common head of German. They were distinguished from, though closely related to, the Frisian and the Anglo-Saxon, and together with them they constituted the West Germanic branch of the Germanic family of languages, the other branches of which were the East Germanic, comprising Gothic, Vandalian, Burgundian, and the North Germanic, or Scandinavian, comprising Swedish, Danish, Norwegian, Icelandic. From the beginning, two main groups may be distinguished: High German and Low German, the former spoken in the hilly and mountainous midland and south, the latter in the low and level north. High German differs from Low German and from all the other Germanic dialects chiefly by the so-called High German shifting of consonants, which probably took place between A.D. 500 and 700. By this process original *d* changed to *t;* original *t,* initial and after consonants (or doubled) to *z* or *tz* (pronounced *ts*), after vowels to a sound similar to *s,* which much later became identical with *s;* original *p,* initial and after consonants (or doubled), to *pf,* after vowels to *ff, f;* original *k,* initial and after consonants (or doubled) in the extreme south only, to *kch,* later *ch,* after vowels to *ch.* A similar change, sometimes classified here, original *th* to *d,* began much later, but spread over the entire High and Low German territory. In consequence of these changes High German differs in its consonants more widely from Modern English than do the Low German dialects. Examples:

English	Low German	High German
day	*dag*	*tag*
tide	*tid*	*zeit*
plant	*plante*	*pflanze*
water	*water*	*wasser*
pipe	*pipe*	*pfeife*
corn	*korn*	(*chorn; Alemannian*)
make	*maken*	*machen*
that	*dat*	*das*

One of the chief divisions of Low German, Low Franconian, gradually separated from the other German dialects and developed a literary language of its own, which in its modern form is called Dutch or Hollandish. Hence «Low German» is sometimes used in the more restricted sense excluding Low Franconian. The dialects thus designated were for a long time used extensively for literary purposes, but gradually High German gained ground, and by the end of the 16th century Low German had almost ceased to be written, the people of the north adopted the common High German literary language for all higher purposes, and the use of the Low German dialects, in their modern form also called Plattdeutsch, was restricted to more intimate intercourse and to consciously dialectic literature. The modern literary language has drawn upon Low German for contributions to its vocabulary, notably terms relating to the sea, navigation and transmarine commerce, but in the main it is based upon High German dialects. The latter form two groups: Middle German and Upper German. Middle German comprises Franconian (not including the Low Franconian mentioned above), and Thuringian, Upper Saxon, and Silesian. Upper German comprises Alemannian with its subdivisions, Swiss and Swabian, and Bavarian, which includes Austrian.

At first all the dialects ranked practically alike, every writer using the speech of his own region. There was, indeed, at first no name of national significance applied to the whole group of dialects; the word *deutsch,* which later came to mean «German,» denoted originally «popular,» and was used mainly of the language of the people as distinguished from Latin, which was the language of church, school and, to some extent, of government. This indicates the beginning of a struggle for pre-eminence between German and Latin which continued for many centuries and which may be characterized by a few especially important facts and dates. Religious writings in poetry and prose are found in German as early as the 8th century, but for a long time the majority of them continued in Latin. About 1230 we find the first code of laws in German, the Low German Sachsenspiegel, also the first history in German, a chronicle of the world (in Low German), and the first legal documents; but for many years afterward Latin continued to be used alongside of the vernacular for all such purposes. The Reformation gave a great impetus to the use of German for all literary purposes, but even in 1570, 70 per cent of all the books printed in Germany were in Latin, and as late as 1691 more than 50 per cent. In the winter of 1687–88 Christian Thomasius gave at Leipzig the first lectures in German in any German university. Even works of poetry were up to the 17th century mostly in Latin. By the end of the 18th century the use of Latin had become generally limited to a few branches of learning, chiefly philology and jurisprudence.

It is customary to divide the history of the German language in three periods. The first of these, from the beginnings to about 1150 (Old High German, Old Low German), was characterized by full inflectional and derivative suffixes, showing a great variety of vowels: *singan, singu, singit, sungun, sungīn, gasungan, salbōta, lebēta, zunga, zungūn, guotēr, guotaz,* etc. From the beginning a tendency to weaken these endings is noticeable and by the end of the period their vowels had, with slight exceptions, been reduced to the indifferent *e: singen, singe, singet, sungen, süngen, gesungen, salbete, lebete, zunge, zungen, guoter, guotez,* etc. Another important change affected the stem vowels, namely, vowel assimilation or «Umlaut», when the suffix contained an *i* or *j, a* changed to *e,* e.g., *gast,* pl. *gesti* (later *geste,* now written *Gäste*); *ū* changed to *ü* (written *iu*), e.g., *hūt* (now *Haut*), pl. *hūti, hiute* (now *Häute*); *uo* changed to *üe,* e.g., *vuoz* (now *Fuss*), pl. *vuozi, vüeze* (now *Füsse*), etc. The change from *a* to *e* took place in the 8th century; the others do not appear in writing until the end of the period. The period was further characterized by crudity of vocabulary and of syntax, the latter due chiefly to the fact that the grammatical means of subordination, viz., relatives, conjunctions, and a characteristic word order, while already in existence, were not yet fully developed. Translations from Latin clearly show the inadequacy of the language to render easily sentences of complex period structure. During the period also a considerable number of words were adopted from the Latin. The oldest stratum of these was due to the first contact with the Romans, from whom the Germans learned some of the fundamental arts of civilization. Hence terms referring to commercial intercourse like *Pfund* (Lat. *pondo*), *Münze* (Lat. *moneta*), *Strasse* (Lat. [via] strata), *Zoll* (Lat. teloneum, Low Lat. *toloneum*), *Meile* (Lat. *milia* [*passuum*]), etc.; the names for the months, *Januar, Februar, März*, etc., which supplanted the native *Wintermonat, Hornung, Lenzmonat*, etc.; terms relating to building, *Mauer* (Lat. *murus*), *Pfeiler* (Late Lat. *pilarius*), *Keller* (Late Lat. *cellarium*), *Kammer* (Lat. *camera*), *Ziegel* (Lat. *tegula*), etc.; terms of agriculture, horticulture, and especially viniculture, *Pflanze* (Lat. *planta*), *Sichel* (Lat. *secula*), *Pflaume* (Lat. *prunum*), *Wein* (Lat. *vinum*), *Winzer* (Lat. *vinitor*), *Essig* (Lat. *acetum*), etc.; terms relating to cookery and eating, *Koch* (Lat. *coquus*), *Schüssel* (Lat. *scutella*), *Tisch* (Lat. *discus*), *Kessel* (Lat. *catinus*), *Becken* (Low Lat. *baccinus*), Kohl (Lat. *caulis*), *Pfeffer* (Lat. *piper*), etc. The second stratum includes the terms relating to the Christian Church, the oldest of them of Greek origin, e.g., *Kirche* (Gr. *kyriake*), *Pfaffe* (Gr. papas), the majority from the Latin, e.g., *Messe* (Lat. *missa*), *Kreuz* (Lat. *crucem*), *predigen* (Lat. *praedicare*), *kasteien* (Lat. *castigare*), etc.; also terms relating to school and the art of writing, e.g., *Schule* (Lat. *schola*), *Tinte* (Lat. *tincta*), etc. Sometimes Latin influence is seen in the make-up of a compound of native elements, e.g., in *Gevatter* = Lat. *compater, Gewissen* = Lat. *conscientia*. Most of the words of these oldest strata have been thoroughly assimilated in form and meaning, and few have ever been given up again.

The second period, from about 1150 to about 1500 (Middle High German, Middle Low German), was characterized by smoothness and melody of sounds, simplicity of grammatical forms, flexibility and variety of construction, and great richness of vocabulary. This was particularly true of the language of Middle High German poetry during the 13th century, which was not inferior to any mediæval language as a means of poetic expression. It showed in all parts of the High German territory such a uniform poetic diction and technique, that scholars for some time assumed for this period the existence of a common literary language ranking above the dialects. This is now generally regarded as overstating the case; the poets traveling much from place to place probably learned to avoid words of distinctly local color and range, but in regard to pronunciation greater variety must have prevailed than the unreliable spelling of later manuscripts and the uniformized spelling of modern text editions suggest. The language of the prose literature of the time, homilies, chronicles, philosophical works, shared in this improvement over that of the preceding period. If the impetus given to literature by the Crusades, by the bloom of chivalry, and by other contemporary events and conditions had continued, it is likely that a common literary language ranking superior to the dialects would before long have developed; but the impetus was of short duration and in the middle of the 14th century we find, together with the decay of chivalry and literature, a rapid deterioration of the language and a great increase of dialect differences. For this reason the time from about 1350 to about 1500 is sometimes reckoned as a transition period. The contact with French knighthood during the Crusades and the predominating social and literary influence of the French during the whole period of chivalry led to the introduction of many French words. Some of them, being technical terms, were given up again with the things they represented; others are still in common use, e.g., *Abenteuer* (Fr. *aventure*), *Lanze* (Fr. *lance*), *Palast* (Fr. *palais*), *prüfen* (Old Fr. *preuf*), *preisen* (Fr. *priser*). German thus gained even two important and prolific suffixes: the Old French verbs in *-ier* (Modern Fr. *-er*) were adopted with the infinitive form *-ieren*, e.g., *parlieren* (Old Fr. *parlier*, Modern Fr. *parler*), and this suffix then spread to other verbs of foreign and later to such of native origin, e.g., *komponieren* (Lat. *componere*), *halbieren, irrlichtelieren*; the French suffix *-ie* (Lat. *-ia*), Middle High German *-ie* gave by regular phonetic change Modern German *-ei*, e.g., *Melodei* (but also, under a reassertion of French influence, *Melodie*), hence *Büberei, Druckerei*, etc.

The third period from about 1500 to the present day (New High German, New Low German), is characterized by the creation of a common literary language and its superimposition upon the dialects. The latter continued to develop and diverge, and an inhabitant of the extreme south would now probably find it difficult, if not impossible, to communicate with one from the north if each could understand only his own dialect. The common language was composed of elements contributed by the dialects, but its spread was not brought about by the assimilation of dialects, but by the substitution of the common language for the dialects for one purpose after another, by one class of the people after another, in one region after another. The beginnings of this common language may be traced back to the middle of the 14th century, by which time German had generally taken the place of Latin in public documents. From 1347 for almost a hundred years the chancery of the empire was located at Prague, in the borderland betwen Upper and Middle Germany. The documents issued from here were written in a language in which Bavarian-Austrian and Upper Saxon elements were blended which was comparatively readily understood in other parts of the country, and which the chanceries of the various German states found therefore easy to imitate. The chancery of the Elector of Saxony was among the first to approximate to the language of the Imperial chancery; others followed and thus a larger and larger part of the country came to make use of a comparatively uniform language for the business of government. The extension of the use of this common language to general literature and finally to all the higher forms of intercourse was largely due to the enormous popularity and deep influence of Luther's writings. The great reformer deliberately and avowedly chose as his medium the language of the Saxon chancery, and he was therefore not, as he has been often called, the creator of the modern German literary language; but while his standard served him well enough in matters of linguistic form, the chancery language, owing to the limited range of subjects treated in public documents, could offer him little help as regards words and idioms. Luther had a remarkable natural command of language, but he also proceeded with the utmost care and spared no pains to learn from the mouths of the people and through his correspondence with men in all parts of the country the most widely understood and yet vigorous and effective forms of expression. Thus the form as well as the substance of Luther's numerous writings caused them to find a ready reception and enormous sale throughout the country, and his prominence in the most important affairs and the most stirring events of the period gave a peculiar authority to the form of his utterances.

The principal formal characteristics of the new common language were as follows:

(1) The diphthongs *uo, üe,* and *ie* of the Middle High German are regularly contracted into *û, ü,* and *î* (the latter continuing, however, to be spelt *ie*): *guot, güete, liebe* became *gût, gûte, lîbe* (spelt *liebe*). This change was originally a Middle German characteristic.

(2) The long vowels *î, û,* and *ü* (spelt *iu*) of the Middle High German are regularly diphthongized into *ai* (written *ei*), *au* and *oi* (spelt *eu*): *mîn* and *hûs* became *main* (spelt *mein*) and *haus* (the English *mine* and *house* have gone through similar changes), and *hüte* (spelt *hiute*) became *hoite* (spelt *heute*). This change was originally a Bavarian-Austrian characteristic.

(3) The diphthongs *ei* and *ou* are regularly changed to *ai* (continuing, however, to be spelt *ei*) and *au: kein* and *boum* became *kain* (spelt *kein*) and *baum*. This was also first a Bavarian-Austrian characteristic.

(4) In the combinations *sl, sm-, sn-, sw-, sp-, st-,* the initial sound has regularly changed to the sound represented now by *sch,* though in the last two combinations *s* continues to be written: Middle High German *slange, smelzen, snîden, swimmen, sprechen, sterne* appear as *schlange, schmelzen, schneiden, schwimmen, schprechen* (written *sprechen*), *schtern* (written *stern*).

(5) A later change, which came about during the period itself, consists in the lengthening of most short stem vowels in open syllables; by analogy many in closed syllables have followed suit. New High German *sâ-gen, fâh-ren, nêh-men, Vâter, Hôf, Wêg,* etc., had originally short stem vowels. On the other hand many originally long vowels and diphthongs followed by more than one consonant have been shortened, hence, *brachte, Mutter, Jammer.*

(6) By the end of the 17th century the old differences between the stem vowels of the preterit singular and preterit plural of strong verbs had been wiped out: *sang-sungen* had become *sang-sangen;* the only exception remaining is *ward-wurden.*

(7) The influence of Latin exercised through the traditions of the chancery language on the one hand, and through the clerical and humanistic training of Luther and his followers on the other, resulted in a cumbersome and greatly involved sentence structure, from which Luther's style in his most popular works, notably his translation of the Bible, is happily free, but which in the writings of others, notably in more or less technical works, has been carried to such excess that it has seriously interfered with the acquisition and spread of the German language among foreigners, and only in modern times has the style of the best writers become reasonably free from this defect. The influence of Latin showed itself further in the vocabulary, not only in the borrowing of Latin terms, but also, as in the first period, in the coining of German compounds on Latin models. During the 17th century, chiefly as a result of the Thirty Years' War, the language became so corrupt with Latin and French words that it was scarcely recognizable. A reaction, however, set in, societies were formed by scholars, writers, and patrons of letters for the purification and refinement of the language, and these conscious efforts for improvement have continued with more or less persistence to the present time, so that the language of the best writers of our day is freer from unnecessary foreign words than that of Lessing, Goethe, and Schiller. Indeed Modern German is, especially compared with English, a very homogeneous language, which shows itself not only in the small number of foreign words, but also in the thoroughness with which most of these have been naturalized in pronunciation and inflection.

In spite of the great influence of Luther and other favorable circumstances it must not be supposed that the introduction of the new literary language did not meet with more or less conscious and unconscious resistance. The south was slower than the north to accept it; being largely Catholic, it looked askance at the «Lutheran» language. The political independence of the Swiss made them ambitious to raise their native Alemannian to the position of a literary language. Not until the middle of the 18th century had all resistance practically ceased, and the German-speaking countries possessed and were conscious of possessing a common literary language. The provincial characteristics which still remain, especially in Austria and Switzerland, are slight in comparison with the unity that has been attained. Moreover the common language has not only supplanted the dialects in literature, government, school, and church, but also in the ordinary intercourse at least of the educated; on the other hand it is still constantly drawing upon the dialects to replenish and rejuvenate its stock of words.

Bibliography.—Rückert, H., 'Geschichte der neuhochdeutschen Schriftsprache' (Leipzig 1875); Socin, A., 'Schriftsprache und Dialekte im Deutschen' (Heilbronn 1888); Behaghel, O., 'Geschichte der deutschen Sprache' (3d ed., Strassburg 1911); Behaghel, O., 'Die deutsche Sprache' (3d ed., Leipzig 1904); Kluge, F., 'Etymologisches Wörterbuch der deutschen Sprache' (8th ed., Strassburg 1914); Kluge, F., 'Von Luther bis Lessing' (4th ed., Strassburg 1904); Diekhoff, T., 'The German Language' (New York 1914).

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8. HISTORY OF LITERATURE. German literature which, as far as its documents are preserved, extends over a period of 15 centuries, may be considered in more than one way a history of the very soul of the German people, reflecting its ideals and innermost aspirations in the productions of the poets and writers of the various centuries, and showing at the same time the development and growth of these ideals and aspirations in their influence upon the people as a whole. «Literature,» says Goethe, «is the fragment of all fragments, the least of what happened and was spoken was put in writing, and of that which was written the least has been preserved.»

There are many reasons for assuming the existence of a richly developed poetry among the Germanic tribes long before we meet any records of it in writing. The nature of this poetry was, without question, that of the poetic productions of most primitive peoples, inasmuch as it originated with their religious cults, their festivities and games, and showed the elements of lyric, epic, and dramatic poetry in their original combination. With this opinion accord the accounts given by Tacitus of old Germanic poetry, according to which its character was partly religious, partly heroic. Later sources assure us of the existence of nuptial poems, funeral hymns, love-songs, and dramatic plays. There was scarcely a manifestation of old Germanic life which was not accompanied and permeated by poetry. But with the exceptions of a number of charms and incantations, such as the *Merseburger Zaubersprüche*, little of this oldest poetry has been handed down to us. Its metrical form was the alliterative verse, as is shown not only by these charms, but also by numerous ancient riddles, proverbs, and the richly developed gnomology of the various Germanic tribes.

The alliterative verse, whose origin was presumably contemporary with the development of the Germanic word-accent, was the metrical form also of the old heroic poetry that flourished chiefly during the time of the migrations, the truly heroic period in the history of the Germanic tribes. The heroic song was cultivated by a special class of rhapsodists whom we find mentioned among the Goths, the Franconians, the Anglo-Saxons, etc. Their lays are almost entirely lost to us, but from the Beowulf and the later Nibelungenlied and the Gudrun, all of which originated among these rhapsodists, we may still form an idea of the greatness of their poetic productions. A fragmentary relic of this early period, though not recorded in writing until about 800, is the *Hildebrandslied*, the highly dramatic account in alliterative verse of the fight between Hildebrand and Hadubrand, father and son.

The chief reason why so much of the oldest German poetry was lost or suppressed must be ascribed to the Church. The introduction of Christianity in Germany meant the decline of popular national poetry as well as the rise of new ideals resulting from the acquaintance with Christian religious life and ancient civilization. Unfortunately it was not the civilization of classic antiquity, but that of the decaying Roman Empire with which the youthful German people were brought into contact.

The earliest German written literature was produced by the clergy, and its chief character, therefore, is learned and religious. As the oldest document of this kind may be mentioned the translation of the Bible into the Gothic language by Wulfila (✝ 381), of which, however only fragments are preserved. They are of the greatest value not only from a linguistic point of view, but also as a document of the intellectual character of the Goths, whose name quite unjustly became synonymous with «barbarous.»

Among the earliest products of Christian poetry in Germany may be mentioned the 'Heliand,' an epic poem in alliterative verse of the 9th century, possessing considerable literary merit in its representation of the story of Christ as the story of a powerful Germanic king. The 'Heliand' was written in Old Saxon, a dialect agreeing in its consonant system with English and Dutch, but differing from Old High German, which was destined to form the basis of the future literary language of Germany. It was due chiefly to the patriotic efforts of Charlemagne, who collected the old Germanic heroic songs and began the writing of a German grammar, that a certain unity in the literary use of the various Old High German dialects was attempted even at this early period, the Franconian dialect attaining, of course, a certain preponderance in this literary language.

Of less poetic value than the 'Heliand,' though displaying the marks of serious literary industry and patriotic sentiment, is the 'Evangelienbuch' by Otfried (ca. 868), a monk in the monastery of Weissenburg. He was the first to employ the rhyme in his work; the structure of his lines still show, however, the rhythmic characteristics of the old alliterative verse.

Otfried's complaint in the Latin dedication of his book to Archbishop Liutbert about the lack of grammatical rules in his mother tongue makes it quite evident that even then a chasm existed between clerical learning and native German speech and poetry. The learned disregard for the poetry of the people, the opposition between artificial and popular poetry, seems to have continued during the 10th and part of the 11th centuries, although in the monastery of Saint Gall we find a laudable exception. Here lived the greatest of the early German grammarians, Notker (✝ 1022), and here the monk Ekkehard I (✝ 973) turned into Latin hexameters one of the famous old Germanic hero-songs, the song of 'Walther and Hildegunde.'

Popular German poetry did not, however, cease to exist during this period; it was cultivated by the Spielleute or traveling minstrels, a class of poets less dignified than the old German rhapsodists, but equally influential. They were the first to seize upon a subject matter which a period, fond of fabulous tales of adventure, as was the age of the Crusades produced in great abundance. Thus a number of epic poems originated of which the charming 'König Rother' is the most important. In the meantime the clergy, who always had a strong antipathy against the minstrels and the worldly spirit of their poetry, turned their literary efforts also in the direction of the epic, choosing their subjects partly from the stories of the Bible, partly from history. But the exclusive literary predominance of the clergy soon had to make room for chivalry which gradually assumed the leadership in matters of literature.

The conditions from which chivalrous society developed in Germany during the 12th century were essentially the same as in England and France. Hence the similarity, too, of ideals: chivalrous valor and virtues, culminating in the «service of ladies.» But although we are still able to follow the paths by which these ideals entered Germany from France, their literary expression in Germany is not merely imitative of French models. It is an acknowledged fact that the great German court epics of Hartmann von der Aue ('Erec,' 'Gregorius,' 'Iwein,') of Gottfried von Strassburg ('Tristan und Isolde') and, above all, of Wolfram von Eschenbach ('Parzival,' 'Willehalm,' 'Titurel') are more than mere translations from the original French versions of these tales, most of which belong to the Arthur legend. In Wolfram von Eschenbach's mind the story of the Holy Grail assumed, in fact, a depth of feeling and thought which makes his 'Parzival' one of the greatest poems of the Middle Ages. The same is true of the 'Minnesong.' This may be seen especially in the songs of Walther von der Vogelweide, one of the greatest lyrists of all times, who proclaimed the divine mission of the poet both in the social and political spheres of human affairs. The beauty and grace of his 'Minnesongs' (love-poems), and the depth and power of thought, the humor and the patriotic and religious pathos of his «sprüche» (didactic poems) were admired long after the dissociation and decline of the court-society had taken place as the result of economic conditions no less than of inherent elements of unnatural and immoral artificiality.

By introducing into his poetry the healthy sentiment of the folk-song Walther von der Vogelweide attempted to stem the degeneration of the Minnesong into artificial unnaturalness, against which the women of the time themselves seem to have occasionally protested. A similar patriotic protest against the popularity in fashionable court circles of Franco-Celtic literary models and subjects seems to have led to the final shaping into epic-poems of the old Germanic hero-legends such as underlie the 'Nibelungenlied,' the 'Gudrun,' and a number of minor poems. Though disguised in these epics as ladies and knights of the 13th century, the characters of the old hero-legend still disclose their original gigantic proportions, and the force of their passions, the grandeur of their struggles and the primitive depth and simplicity of their feelings contrast strongly with the fantastic picture of court-life portrayed in the contemporary court-epics.

The period of classical productions during the latter part of the 12th and the beginning of the 13th centuries was followed by a period of poetic dearth in which great literary activity was, however, not wanting. The place of the chivalrous Minnesingers is taken by the so-called Mastersingers, mostly honorable citizens and tradesmen, fond of cultivating the didactic, the mystic and abstruse in their songs. A similar decline we notice in epic literature. At the same time we may, however, observe the beginnings of new forms of literary expression, such as prose, the drama, and folk-song, all of which were developed especially during the 15th and 16th centuries.

During the classical period of Middle High German literature a general uniformity in the language of poetry had been sought and, to a certain degree, attained by the best writers. It was essential that a like uniformity, displacing the various dialects, should be established for the literary use of German prose which, from the 13th century on, had been employed more and more in sermons, mystical writings, and in chronicles. According to the testimony of Luther (1483–1546) he found the form of German prose, which became so powerful an instrument in his hands, in the language used by the imperial Saxon chanceries. It was Luther's genius and great personality which assured this Saxon dialect the future literary predominance over the other High German dialects. For the language of his classical translation of the Bible and his powerful church-hymns soon became the authority for the grammarians and the best writers.

The origin of the German drama must be traced to the simple dramatic representations given by the Church at Easter, Christmas, etc., the old Germanic plays having gradually died out. How popular these performances soon became may be seen from the great number of Easter, Christmas, and Passion plays, of Carnival plays and farces which have come down to us. It is the dramatic form gradually developed in these plays which we find also in the dramas of Hans Sachs, the foremost German dramatist and mastersinger of the 16th century. An enthusiastic admirer of Luther and his work, Hans Sachs (1494–1576) did inestimable service to the cause of Reformation by popularizing its ethical ideas in his numerous dramas, farces, and poems.

The most perfect poetic productions of the 15th and 16th centuries are, however, the 'Volkslieder' (folk-songs), the direct and artless expression in verse of inimitable beauty and simplicity of the very soul of the people, who were then still feeling and thinking as a whole, and were as yet undivided into the learned and the unlearned. The discovery later by Herder of the truth, the ethical force, and the beauty in which human nature reveals itself in these songs, contributed greatly to the rejuvenation of German life and literature during the 18th century and afterward.

Great as the influence of the Renaissance was on the intellectual life of Germany during the 16th century, the indebtedness to this influence of the really great writers, of men like Luther, Hans Sachs, and even Johann Fischart, was after all comparatively small. The attempt to reform German literature after the model of the ancients was, however, made during the 17th century by Martin Opitz (1597–1639). The principal features of this attempt, the effects of which are noticeable even in the classical literature of the 18th century, were the breaking with the life and the literary traditions of the past, and the beginning of an entirely new literary development. While in matters of metrics Opitz's reform was fully justified, this reform meant, nevertheless, mere imitation and the introduction of a literature of the learned for the learned. The people as a whole were forgotten, if not disregarded; the writing of poetry became, as with the Neo-Latinists of the 16th century, a conscious labor, the result of reasoning and calculation instead of the product of the free play of inspired imagination.

Neither Opitz nor his more gifted immediate followers produced poetry of more than ordinary value. In their endeavor to surpass the former and by their imitation of contemporary Italian and Spanish models the writers of the next generation, known as the Second Silesian School, ended in bombast and filthy sensuality. Much of the pitiable condition into which German literature fell during the 17th century was, of course, due also to the degenerating effects upon the intellectual, political, and social life of Germany produced by the Thirty Years' War.

It was due to the efforts of numerous noble and patriotic men during the 18th century that German literature as well as German life underwent a great regeneration. The rejuvenation of the German nation and of mankind in general was, in fact, the ultimate aim in the efforts of all the great thinkers and poets of this period, and nowhere can we follow this process better than in their writings.

Long before Rousseau's panacea, «back to nature,» became the watchword in literature, we notice in these writings the endeavor to find, independently of the ancients, nature, truth and reality. Poets like A. von Haller (1708–77) and F. von Hagedorn (1708–54) discover the rich inner world of man as the only great object of poetry. And in C. F. Gellert (1715–69) the preclassic period produced a writer of extraordinary popularity. A harmonious personality who discarded traditional learning, he exerted a liberating influence on his time by pointing to the human *heart* as the source of true life.

Hand in hand with these attempts of the poets proceeds the work of criticism in ascertaining the nature of the beautiful and thereby the nature of what constitutes true humanity. It is characteristic of German poetry since Opitz that the creative activity of the poets is accompanied by a conscious reflection concerning the nature of poetry: thus it came about that Lessing, Herder, Schiller, and Goethe were also great critics.

The discovery by the Swiss critics, Bodmer and Breitinger, of the imagination as the true source of poetry prepared the way for the first great poet of this period, F. G. Klopstock (1724–1803). The influence which the latter, through his ‹Messias› and his ‹Oden,› exerted upon the intellectual, the moral, and the political life of his people was extraordinary. In him the old Germanic conception of the poet seemed revived; he regarded his calling as that of a priest and a prophet and his highest ideal was that of true humanity.

Yet Klopstock's principal work, the ‹Messias,› was, with regard to the subject matter and its treatment, a mistake. It was the task of Lessing (1729–81) to establish the laws of poetry, particularly those of the epic and of the drama. This he did in the ‹Laokoön› and in the ‹Hamburgische Dramaturgie.› A fearless critic and searcher for truth, he was also the first great German dramatist of this period. The characters of his famous plays, *Minna von Barnhelm* and *Emilia Galotti*, breathe real life, embodying at the same time the poet's new and manly conception of human life. And through his theological writings, his ‹Erziehung des Menschengeschlechts,› and his drama, ‹Nathan der Weise,› he exerted a reformatory influence not only upon theology, but also upon the religious life and conduct of his country.

In Lessing's path as a critic followed J. G. Herder (1744–1803), one of the most remarkable geniuses of this period. Correcting and supplementing Lessing's discoveries in his early writings, Herder soon became a critical pathfinder who pointed out with prophetic instinct the course which the intellectual development of Germany was to take. To him is due above all the momentous discovery of the true nature of popular poetry and, moreover, a conception of history such as no previous historian had thought of.

With Herder began the so-called «Storm and Stress» period, the revolution in German intellectual life, whose ultimate aim it was to break with previous traditions and to attempt the regeneration of human nature, the beginning of a new life from the innate eternal sources of the soul. The result of this remarkable movement was the classical German literature of the 18th century, the chief representatives of which are Goethe (1749–1832) and Schiller (1759–1805). Goethe's earliest works (‹Götz von Berlichingen,› ‹Werther,› his early lyric poetry and the oldest scenes of ‹Faust›) as well as Schiller's first dramas (‹Die Räuber,› ‹Fiesco,› ‹Kabale und Liebe›) show us the spirit of the literary revolution in its whole force and depth. In the works of the mature period of both poets, with Goethe's ‹Iphigenie,› ‹Tasso,› ‹Hermann und Dorothea,› ‹Wilhelm Meister,› etc., and with Schiller's ‹Don Carlos,› ‹Wallenstein,› ‹Wilhelm Tell,› and his æsthetic essays, German literature reaches its highest perfection both as to form and contents. It is the ideal of humanity which lives in the best works of these poets and lends them an imperishable charm. Poetry is no longer an imitation of the ancients, but the highest human creative power which, independent of science and religion, strives to solve the riddle of the world and of man. In the creation of this new ideal of humanity the example of the ancients was, no doubt, most helpful, but it was, after all, essentially a product of the German mind, to which the great thinkers, Kant, Fichte, Schelling, and Hegel contributed their share also.

That the new German spirit, created by the co-operation of the poets and philosophers, gradually became recognized as a powerful influence outside of Germany, that its political significance for the fatherland was emphasized, and that in place of the abstract cosmopolitanism to which even Goethe and Schiller were inclined, the conception of nationality was established, was due to the Romantic School, which in the main was a continuation of the storm and stress period, particularly of Herder's ideas and discoveries. Two groups of writers may be distinguished in the Romantic School, an older and a younger one. Although the members of the older group, Friedrich Schlegel, Novalis, A. W. Schlegel, and L. Tieck, were lacking in plastic creative power and were frequently losing themselves in fantastic dreams or in the clouds of mysticism, they glorify the mission of the poet and revel in the enjoyment and appreciation of beauty in art and nature. Hence they excel chiefly as critics, interpreters and translators, and the influence of their new approach to life upon art, music, science and even politics and religious life was extraordinarily great. It was the spirit of Romanticism which, in protest against abstract rationalism of the 18th century, inspired the distinguished theologian and philosopher, Friedrich Schleiermacher (1768–1834) to write his famous 'Reden über die Religion,' and it was the same spirit from which emanated the Hegelian conception of the state as the realization of the mind of the people or the embodiment of the divine idea. To the Romantic School, finally, belongs the credit for the revival of the historical understanding and of the discovery of the beauty and greatness of German antiquity as revealed in the art and literature of the Middle Ages, the investigation of which was undertaken by the brothers Grimm, by L. Uhland and by their numerous followers. An even greater effect upon the awakening of national consciousness and the desire for German unity was made by the political humiliation and the military oppression to which Napoleon I had subjected the German people. The powerful and impressive 'Reden an die deutsche Nation' by the great philosopher, J. G. Fichte (1762–1814), the passionate and lofty patriotic lyrics of E. M. Arndt, Theodor Körner, Max von Schenkendorf and Friedrich Rückert, and the patriotic plays of the eminent dramatist, H. von Kleist, roused the nation from its political lethargy and despair, and gave evidence of the transition from dreaming to action which then took place in the German mind and affected future literary expression.

The national hopes fanned by patriotic feeling during the wars of liberation remained unfulfilled, however, and a period of political stagnation and depression followed during which the younger group of Romanticists, the great singers, L. Uhland (1787–1862) and Joseph von Eichendorff (1788–1857), and the novelists, C. Brentano, A. von Arnim and E. Th. A. Hoffmann, hold the attention of the nation. Other writers such as the talented Austrian dramatists, F. Grillparzer (1791–1872) and A. von Platen (1796–1835), follow essentially in the footsteps of the German classics, as had at the beginning of the century Friedrich Hölderlin (1770–1843), the author of the novel 'Hyperion,' a story full of patriotic and heroic prophecies, and of a collection of lyrics of exquisite beauty. As the chasm between the ideal world created by the poets and thinkers and the wretched political and social reality of the time had weighed heavily upon Hölderlin, so it was felt even more keenly by the younger men who had fought for freedom and a united Germany. Disgusted with the turn of things numerous scholars and professional men emigrated to America. Chief among them were Karl Follen, the later champion of abolitionism and religious freedom in this country, and Karl Postl (Charles Sealsfield), the great novelist. While literature and philosophy remained the principal objects of national interest even after the wars of liberation we may notice during the third decade of the century a gradual awakening of the desire for the realities of life. Elements of realism as well as a forecast of later social and democratic tendencies appear already in the work of Jean Paul (Richter) (1763–1825), Germany's foremost humorist. The strides made by the natural and applied sciences, the unprecedented industrial development with its subsequent economic changes, nourish still further the growing sense for the concrete and the actual which finally was to make itself felt also in literature and philosophy. A group of writers, generally known by the name of "Young Germany," were the first to champion the new spirit of the time. The cry for a common national feeling and for real life in place of abstract knowledge and learning is heard, especially strong, in the 'Æsthetische Feldzüge' of L. Wienbarg, a series of lectures containing the program of the new school. While most of the members of this school (L. Börne, H. Heine, Karl Gutzkow, H. Laube) still show the Romantic influence, they protest in the name of liberalism against the reactionary tendencies of degenerate Romanticism and, following certain contemporary movements in France, proclaim a curious mixture of democratic and socialistic ideas. With the exception of Heine, whose lyric poetry attained wide popularity, the writers of Young Germany were chiefly journalists and essayists who created a new style of prose, but their attempts in the fields of the drama and the novel did not produce literature of permanent value. The realism coveted by them so eagerly was attained, however, in a remarkable degree in the graphic pictures of American life and landscape contained in the stories of the German-American novelist, Charles Sealsfield (1793–1864). Undisturbed by contemporary literary feuds two of the foremost German lyricists produced their best songs during this period: Nicolaus Lenau (1802–50), the forerunner of later pessimism in literature, and Eduard Mörike (1804–75) in whose poetry and stories the best traditions of the folksong and of German classicism are revived. On the other hand, the struggles for national unity and political freedom which stir the German mind during the subsequent decade and culminate in the Revolution of 1848 are reflected in the patriotic poetry of such men as Georg Herwegh, Ferdinand Freiligrath, Hoffman von Fallersleben and Emanuel Geibel.

The failure of the revolution, due chiefly to abstract professorial theorizing and to the fruitless wrangling of the liberal and conservative factions, left the nation in a state of depression even worse than that after the wars of liberation. It was during this period that the materialistic theories of Ludwig Feuerbach (1804–72) and the pessimist philosophy of Schopenhauer (1788–1860) gained their widespread influence which few writers could thereafter entirely escape. Nevertheless we find during the fifties and sixties, the period sometimes called the "silver age" of modern German literature, a number of highly talented dramatists and novelists whose best work is at least in part of permanent value, and foreshadows in some respects the literary development of the future. The principal figure among these writers is probably Friedrich Hebbel (1813–63), next to Kleist, the foremost German dramatist of the 19th century. Although his dramas show a decided tendency toward philosophical reflection, the result of the author's study of the æsthetic theories of Hegel and Schopenhauer and the lack of the background of a richly developed national life, they give evidence of great dramatic power, of a masterly technique and of a psychological treatment quite in contrast to the poet's usual predilection for abstract ideas. Among his plays 'Judith,' 'Maria Magdalena,' 'Agnes Bernauer' and 'Die Nibelungen' may be mentioned as his most noteworthy efforts. Compared to Hebbel, Otto Ludwig (1813–65), a contemporary dramatist, possessed the greater poetic talent and excelled his rival as an outspoken realist, but his most successful plays, 'Der Erbförster' and 'Die Makkabäer,' though rich in wonderful details, do not attain Hebbel's dramatic force nor his art of constructing a strong plot. Ludwig's story 'Zwischen Himmel und Erde' is one of the finest early specimens of the realistic novel in German and his famous critical 'Shakespearestudien' in many respects paved the way for the later development of the German drama.

While, on the whole, conditions in Germany were not favorable to the development of the drama during this period, prose fiction in the form of the novel and the short story flourished all the more. Its chief representatives are Karl Gutzkow ('Die Ritter vom Geist'), Gustav Freytag ('Soll und Haben,' 'Die verlorne Handschrift'), Gottfried Keller ('Der grüne Heinrich,' 'Die Leute von Seldwyla'), Theodor Storm, Paul Heyse, and the writers of village stories such as Jeremias Gotthelf, Berthold Auerbach, Melchior Meyr, and their numerous followers. The most original of these novelists, a master of the first rank, whom Paul Heyse fittingly called the Shakespeare of the German novel, is the Swiss writer, Gottfried Keller (1819–90). Next to him in eminence ranks Theodor Storm (1817–88), a prose poet whose 'Novellen' or short stories, like those of Keller, present in its most consummate form a kind of story which seems unknown in English literature. The revival of the study of German antiquity, so eloquently advocated by the Romanticists as a means of national regeneration, remained one of the most potent literary forces during the entire century. Its influence can be seen in the effect of the collections of old German folksongs by Clemens Brentano and A. von Arnim ('Des Knaben Wunderhorn,' 1808) and by Uhland ('Alte hoch und niederdeutsche Volkslieder,' 1845), in the popularity of the translations of the old German poetry such as the 'Nibelungenlied,' the 'Gudrun,' and the songs of Walther von der Vogelweide, or of historical novels dealing with old German life such as W. Hauff's 'Lichtenstein' (1826), V. Sheffel's 'Ekkehard' (1862), and G. Freytag's grand prose epic, 'Die Ahnen' (1872–80), preceded by his classical historical sketches, 'Bilder aus der deutschen Vergangenheit' (1859–62). The most artistic and permanent expression of the movement aiming at a national regeneration by means of a renewal of the spirit of Germanic mythology and hero-legend is to be found, however, in the music drama of Richard Wagner (1813–83). It is insignificant, therefore, that the first performance of the 'Ring der Nibelungen' (1876) in the 'Festspielhaus' at Bayreuth, a few years after the establishment of the German Empire, was considered by contemporaries as the festive dawn of a new era of German art.

The fulfilment of patriotic hopes and wishes which the national rising of 1870 brought was, however, slow in manifesting itself in literature. Music, the plastic and graphic arts, and the natural sciences had taken the position which poetry had hitherto occupied in the German mind. Under the leadership of Bismarck's towering personality, the very embodiment of elemental will power, a new spirit soon began, however, to pervade the nation, directing its energies from mere thinking and dreaming to a life of action and to a new sense of the concrete in every sphere of life. Filled with this new spirit and encouraged by certain foreign authors, such as Zola and Ibsen, a group of young men undertook during the eighties to reform German literature along the lines of naturalism and to win back for it its lost prestige in the estimation of the nation. Much in this movement was abstract theorizing and fruitless æsthetic experimentation of doctrinaires, whom Goethe would have called "forced talents." In their futile effort to vie with the method of exact science the real leaders of the movement found, however, a new way of observing reality and of reproducing what they considered "life." This new literary technique, the only permanent contribution to literature of the movement, manifested itself first in the revival of lyric poetry, represented by such men as Arno Holz, Karl Henckel and especially by Detlef von Liliencron (1844–1909), the greatest poetic talent among these early impressionistic lyricists. It was, however, through the novel and the drama that the militant naturalists carried on their chief campaign. Stories such as Liliencron's 'Kriegsnovellen' (1893), W. von Polenz's 'Büttnerbauer' (1895), Hermann Sudermann's 'Frau Sorge' (1887), Georg von Ompteda's 'Sylvester von Geyer' (1897), and Helene Böhlau's 'Der Rangierbahnhof' (1896) are some of the best specimens of the new realistic romance, to which also an older master, Theodor Fontane (1819–98), contributed several of his maturest works ('Irrungen, Wirrungen,' 1888, 'Effi Briest,' 1895). Yet it was in the field of the drama that the realistic movement created its most permanent values and won its greatest success. It was inaugurated with much noise by several dramas such as Holz-Schlaf's 'Familie Selicke' (1890) and Gerhardt Hauptmann's 'Vor Sonnenaufgang' (1889) and 'Die Weber' (1892) in which the young playwrights, all careful students of Ibsen, presented a photographic picture of social conditions as they saw them and as they agreed with the strong socialistic tendency of the times. The fact that many of these pictures accentuated the ugly and gloomy aspect of life was due, however, not only to a clearer vision of reality and to strong socialistic sympathies, but also to the pessimistic mood which had enthralled the German mind for generations and had been the dominant note even in Wagner's music drama. That the German spirit was liberated from this mood, that in place of senile pessimism it embraced a youthful optimism, the will to live, to face the problems of the present and to love life, that the individual freed itself from the bonds of tradition and the uniformity of mass life and took courage to become what it was destined to be: a free personality striving continually toward the more perfect and beautiful life of a higher humanity, was the work of the poet-philosopher Friedrich Nietzsche (1844–1900). Much in his aphoristic teachings, expressed in the most exquisite German prose, which becomes mannered only when it affects the language of the Sermon on the Mount, was exaggerated, misleading and transitory, but the influence of his chief work 'Also sprach Zarathustra' (1883-91), upon the literature and the intellectual life of Germany in general has been very great. A pathfinder and perhaps a prophet, who fell a victim to the inner struggles of a time of transition, his message produced above all a deep longing for new religious and ethical values and a revival of the idealism of the classical and romantic period. The return to the inborn idealism of the German mind without sacrificing the best attainments of the realistic movement can be seen in the career of Gerhardt Hauptmann (b. 1862), Germany's greatest contemporary dramatist. It is noticeable already in the fairy drama 'Hannele's Himmelsfahrt' (1893) and becomes more pronounced in the subsequent plays 'Die versunkene Glocke' (1896), 'Michael Kramer' (1900), 'Der arme Heinrich' (1902), etc. The recovery of the domain of imaginative freedom, the emancipation of personality and the reverence for beauty which the Neo-Romantic revival of the last decades brought, are evident also in the new novel and in the new lyric of this latest period. While there is no genius of the depth and greatness of a Goethe and a Schiller, or even of a Novalis and Hölderlin among the present writers, there is an abundance of eminent talent of which any country might be proud. The work of novelists like Thomas Mann ('Die Buddenbrooks,' 1901), Arthur Schnitzler, Clara Viebig ('Die Wacht am Rhein,' 1902), Isolde Kurz ('Italienische Erzählungen,' 1895), Hermann Hesse ('Peter Camenzind,' 1904), and Ricarda Huch ('Ludolf Urslen,' 1893) and of lyricists like Richard Dahmel, Hugo von Hofmannsthal and Stefan George — to mention only a few representative names — bears witness to the weightiness of content and the finish of artistic workmanship at which the German literature of the present has arrived.

Bibliography.— Gervinus, G., 'Geschichte der poetischen Nationalliteratur der Deutschen' (2d ed., 1871-74); Koberstein, A., 'Grundriss der Geschichte der deutschen Nationalliteratur' (6th ed., 1884); Goedecke, K., 'Grundriss zur Geschichte der deutschen Dichtung' (2d ed., 1884 ff.); Wackernagel, W., 'Geschichte der deutschen Dichtung' (2d ed., 1879-94); Scherer, W., 'Geschichte der deutschen Literatur' (10th ed., 1905), English translation by Mrs. Conybeare (new ed., 1906); Vogt, F., und Koch, Max, 'Geschichte der deutschen Literatur' (2d ed., 1902); Bartels, A., 'Geschichte der deutschen Literatur' (1901-02); Biese, A., 'Deutsche Literaturgeschichte' (1907-11); Robertson, J. G., 'History of German Literature' (1902); Francke, Kuno, 'History of German Literature' (6th ed., 1903); Koegel, R., 'Geschichte der deutschen Literatur bis zum Ausgang des Mittelalters' (1894-97); Hettner, H., 'Geschichte der deutschen Literatur im 18. Jahrhundert' (4th ed., 1894-95); Meyer, R. M., 'Die deutsche Literatur des 19. Jahrhunderts' (4th ed., 1910); Bartels, A., 'Die deutsche Dichtung der Gegenwart' (7th ed., 1907); Lewisohn, Ludwig, 'The Spirit of Modern German Literature' (1916).

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9. HISTORY OF SCIENCE AND PHILOSOPHY. The German nation has often been called a people of «thinkers.» That had perhaps in the past sometimes a slighting implication, as if the Germans lived in a world of dreams and were unfit for success in the practical world of reality; only the last decades have removed completely such a tacit meaning, since the German Empire has proved itself not less strong in its achievements in commerce and industry and politics than in the fields of science and scholarship. Yet, on the whole, it was at all times a sincere acknowledgment of that German contribution to the progress of human civilization which has been most original and most lasting. German earnestness and thoroughness, German love of truth and of freedom, have blended, at least twice since the days of Leibnitz, into a productiveness of knowledge which is not paralleled in the world.

1. The most valuable contribution of the earliest times was the historiography done in the German cloisters. Their «annals» were faithful work and Einhardt's 'Life of Charlemagne' (written 820) is a noble piece of history writing. But the scholarly thought was still essentially imitative. When in the 9th century the Benedictine Rhabanus Maurus in the cloisters of Fulda wrote his encyclopædia 'De Universo,' in 20 books setting forth the status of German knowledge in the time of Charlemagne, it was on the whole a repetition of that which Isidor of Sevilla had brought together in the 7th century. All thought about nature was controlled by the ancients. And when in the 11th century a new European movement of thought was growing, the great scholastic effort to harmonize belief and reason, France, Italy and England gave the signal. Yet Germans, as, for instance, Hugo, Count of Blankenburg, took an important part, and Albert von Ballstädt, called Albertus Magnus (1193-1280), was one of the deepest and most brilliant scholastic thinkers, whose knowledge of natural science, too, was far superior to his age. Theologians and philosophers of repute, like Thomas von Strassburg, followed in the 14th century and certainly no thinker of the 15th century equalled the Cardinal Nicolaus von Cusa (1401-61), who combined scholasticism and Platonism, mathematics and theology. In the meantime Germany had founded its famous seats of higher learning, the universities, which have been always at the same time schools for the professional training of clergymen, teachers, doctors and lawyers and centres of productive scholarship. (See GERMANY, UNIVERSITY SYSTEM IN). Through the 13th century the University of Paris was the point of crystallization for scholasticism; in 1348 the first German university was founded in Prague, soon after that the University of Vienna and Western Germany followed immediately with Heidelberg (1385) and Cologne (1388). The political disturbances in Boehmen brought about a secession in Prague, and its immigrating scholars founded the University of Leipzig (1409). These new centres of scholarly influence increased the independence of German scholasticism of the dogmas of Paris, and in the declining period of mediæval thought the German systems of nominalistic philosophy played an important rôle.

The opposition to the hairsplitting rationalism of scholastic thought came from two movements which better expressed the German instincts: mysticism (q.v.) and humanism (q.v.). Mystical speculation became influential from the beginning of the 14th century; in an immediate personal unity with God there was sought a deeper knowledge than that of Church and university. Meister Eckhart's pantheistic mysticism, a Christian neo-platonism, stands with such daring independence against the doctrines of the hierarchy that it must be acknowledged as the first original German philosophy, in spite of its unsystematic character. The mystical schools develop themselves, especially in western Germany, through the 15th and 16th centuries and emphasize now the theological interests or even the practical religion (Thomas à Kempis, 'Imitation of Christ'), now the naturalistic interests. The mystical study of nature was most strongly influenced by the physician Paracelsus (1493–1541). His aim was a fundamental reform of medicine, which had still the stamp of Galen and Avicenna. But to understand man's body the microcosmos must be understood as image of the macrocosmos and thus natural science, astronomy, and theology become the basis of medicine. His numerous writings influenced, through all Europe, medicine, alchemy, and theosophy. The last great mystic was Jacob Boehme (1575–1624), whose speculations concerning God's relation to the world and its evils became influential through the following centuries.

Far more systematic and scholarly was the opposition which arose against scholasticism from the humanistic side. The European Renaissance which flourished from the 14th to the 16th century found nowhere a more enthusiastic echo than in Germany. The best minds entered into its service and here, too, the movement took a threefold form: it created the historical æsthetic interest in the literary treasures of classical antiquity, it opened the eyes to nature and it liberated from the mediæval onesidedness of christianized Aristotelianism. The time thus demanded philology, natural science, and independent philosophy. The great philological movement was carried by Germans like Johann Wessel, Rudolph Agricola, Johann Reuchlin (1455–1521), whose handbooks and editions stimulated the study of Latin and Greek throughout Germany, and who at the same time inaugurated the study of the Hebrew language in western Europe; Erasmus of Rotterdam (1457–1537), the most eminent scholar and the most witty writer of his time, who published the first edition of the Greek New Testament, and whose writings fill 24 folio volumes; and above all the "teacher of Germany," Philipp Melanchthon (1497–1560). Famous as theologian and diplomatist, he desired to be in first line philologist and expounder of the classics. For 40 years he taught in Wittenberg. His 'Loci Communes' appeared in 60 editions during his lifetime.

The return to nature and the striving for scientific knowledge is expressed in great scholars like the mathematicians and astronomers Nicholas von Cusa, Georg Peurbach, Regiomontanus (1436–76), famous for his 'Ephemerides ab Anno'; Martin Stöffler, and epoch-making Copernicus (1472–1543), whose discovery that the planets moved around the sun was worked out in 'De Orbium Celestium Revolutionibus.' The movement culminated in Johann Keppler (1571–1630), who discovered that the planetary orbits are elliptic and that the squares of the periods of revolution of any two planets are to each other as the cubes of their mean distances from the sun.

Humanism thus brought to Germany ample results in the fields of philology and natural science, but seemed without such results in that field in which the other countries gained most by the Renaissance: philosophy. The German philosophical humanistic reaction against mediævalism (q.v.) and scholasticism (q.v.) was inhibited by the religious movement which absorbed Germany's metaphysical energies — Protestantism (q.v.). The Protestant religion, no doubt, ultimately reinforces knowledge and scholarship. Its appeal to the sources, its attack on authority, liberates the spirit of criticism and research. The great progress of Germany's scholarship in all fields in the 19th century is the work both of the Protestant parts of Germany and of the Catholic regions. German philosophy, more than any other branch of knowledge, shows the Protestant character from Leibnitz to Kant and Fichte and Hegel. But in the days of the new awakening, when Italy and France and Holland and England produced great philosophical systems, Protestantism necessarily inhibited the metaphysical movement in Germany.

Scholasticism had been a union of Church theology with rationalistic philosophy, an effort to bring the religious belief into harmony with reason. The Reformation agreed, of course, with the new humanistic antagonism against those scholastic systems, but not in the interest of an independent philosophy, rather in the interest of an independent theology — independent alike of the Church and of abstract logic, faithful only to the individual religious instinct and to the revelation of the Scriptures. Martin Luther, with his mystical tendency, had no sympathy with the logical definitions of human thought and no trust in the power of merely human intellect. The humanists who in the first decades of the 16th century defeated the scholastic world and who fought for literary-æsthetic ideals and platonistic philosophy soon felt that the Lutheran movement was unfriendly to the cherished arguments. It is true, Zwingli stood nearer to philosophy, and Melanchthon became a most influential teacher of philosophical doctrines; his philosophical writings, not only the commentaries to ancient philosophers, remained the best books of Protestant Germany for a century. Yet Melanchthon, too, was more original as theologian than as philosopher. The theological discussions filled the time and reached the masses, and the humanistic movement, which fascinated the few, was necessarily the loser in Germany. The increase of religious strife was accompanied by a decrease in independent interests of thought throughout the land. The lowest point was reached when the Thirty Years' War destroyed the power and prosperity of the commonwealth; the moral and intellectual energies of Germany seemed paralyzed and German universities and German scholarly interest had never so little dignity and authority in the world as through the first two-thirds of the 17th century. Naturalists and philosophers like J. E. Sturm or

Joachim Jungis stood under the influence of the great French thinkers, and even the famous jurist Samuel Pufendorf (1632–94), the first German teacher of natural law, is under foreign leadership. Indeed, the neighboring countries had incomparably better conditions for scholarly activity than the devastated land of Germany, and while they did their utmost to reinforce the spirit of productive scholarship through the founding of academies and the high social position of the scholars, Germany had no academies and no protectors of knowledge; university life itself became vulgar and barbaric.

The new spirit had thus to come from foreign lands. The French language and literature and philosophy entered at first the courts of Germany and soon after its universities; the humanistic neo-classical interests were replaced by the more «modern» efforts which had been developing in the neighboring country since the days of Descartes. The universal thinker who stands at the threshhold of a new and better time is Leibnitz.

2. Gottfried Wilhelm von Leibnitz (1646–1716), a man of the great world, brought German thought in contact with the advanced scientific spirit of France, Holland and England. Through his influence the Berlin Academy was founded in 1700 with the aim to create a place for the real advancement of knowledge at a time when the universities felt, on the whole, satisfied with handing down the scholarly traditions. He created the most elegant instrument of natural science: the differential calculus, which he published (1684), in his essay 'Nova methodus pro maximis et minimis.' But still more important was his metaphysical system. It shared with Descartes and Spinoza the rationalistic belief in the power of transcending experience through reason, but Descartes' sharp separation of mind and body and Spinoza's monism were left behind by Leibnitz's «monadology.» His monads, held together by pre-established harmony, represent a continuous series of simple substances which are without windows, each containing the whole world as perceptions, but each apperceiving only a varying part of them. His system fulfils in an original way the purpose of every great philosophy: to justify and to harmonize both the causal, mechanical, and the teleological idealistic knowledge of the time. And thus Germany had finally, as the last of European nations, a real philosopher who was to introduce the enlightenment of the 18th century.

While Leibnitz brought the modern interests to the German courts and academies, the universities, too, reflected the progressive time. Halle, founded in 1694, and Göttingen, founded in 1737, became the new centres of an activity which had no sympathy with the doctrines of authority, either the theological ones of the church or the classicistic ones of the humanists. An independent free thought, working with mathematics and logic and empirical observation, was the demand of the time in every field. The jurist Thomasius (1655–1728) became the leader of the academic movement of protest against all narrowness and prejudice, fighting alike against the mediæval methods of legal and equivocal prosecution, against the superstitions of orthodox theology, and against the artificiality of classical learning. He was the first to emancipate German university instruction from the traditional Latin and to publish a literary critical magazine in the German language. After conflicts with Leipzig he became one of the founders of Halle, and his spirit of modern intellectualistic enlightenment came to be characteristic of the place. To be sure, on theological grounds the opposition against orthodoxy did not move so much toward theoretical rationalism, but took at first the turn toward practical religiosity. The great pietistic anti-clerical movement which Spener (1635–1705) started, influenced by English puritanism, was continued in Halle by Francke (1663–1727), to whom true Christianity was not an object of science but a living duty; and yet even the insistence on the Bible as the only true source of religion meant here, as two centuries before in Luther, in first line not a binding of the free intellect, but a liberalizing and modernizing opposition against the orthodox spirit of the past. The full development of theological criticism in Halle belongs rather to the influence of Semler (1725–91), whose historical interpretations of the Bible open the way for the new rationalistic theology.

The most influential separation from church authority, however, on all fields of human thought came through Halle's fertile philosopher, Christian Wolff (1679–1754). His system was no great original construction — it was essentially Leibnitzian philosophy — but it gained its new strength and power by being really a system. Dogmatic rationalism herein reached its most self-conscious expression and Wolff's didactic treatment of ontology, cosmology, psychology, theology, ethics, economics, and politics soon penetrated the whole Protestant scholarship of Germany. Theology and metaphysics, morality and jurisprudence had to become «natural» and «rational»; the ideals of mathematical knowledge and social happiness determined the whole period. The Leibnitz-Wolffian movement was not without opponents like Crusius and Rüdiger, and yet the adherents carried the day. Among Wolff's pupils, besides interesting philosophers like Bilfinger and Lambert, Baumgarten (1714–62) must be mentioned as the founder of German «æsthetics,» a name which he invented. The scholarly rationalistic philosophy yielded quickly to its natural tendency to subserve the practical purposes of human virtue and happiness, to be reached by the emancipation of the individual from every authority but its own reason, and with this practical aim came the tendency to popularization. It was a movement to which Frederick the Great lent himself from the Prussian throne, and authors like Moses Mendelssohn and Reimarus, Nicolai and Engel, Tetens and Moritz spread it throughout Germany. Here also is the place for the important scholarly writings of the poet Lessing (1729–81), who stimulated theoretical æsthetics as well as philosophy of religion and philosophy of history.

While thus the new philosophical and theological spirit of the 18th century radiated from Halle, it was the University of Göttingen in which the new scientific and philological impulses started, till finally the light came from Königsberg. In Göttingen taught (next to Linnæus most eminent biologist of the time) Albrecht von Haller (1708–77), famous for his botanical books, but still more influential by his medical studies. He introduced the physiological experiment, and his demonstrations of what he called sensibility and irritability of nerves and muscles, became the starting point for biological theories which controlled the medical discussions of Europe down to the time of cellular pathology. Among those who took part in these physiological, pathological, and therapeutical controversies of the 18th century Frank, Weikard, Röschlaub, Pfaff, and others belong to Germany; and especially the group of those who defended that branch of Haller's system which had found its development in France under the name of vitalism: Blumenbach, Reil, and Hufeland. Blumenbach (1752–1840), who interprets the organic world by his "nisus formativus," became the founder of anthropology; the doctrine of the five human races is his. He was also the first to lecture on comparative anatomy. Reil considers life as a galvanic process, and with Hufeland the doctrine of animalism becomes practical medicine. Side branches of this vitalistic movement are mesmerism and homœopathy, whose founders, Mesmer (1734–1815), and Hahnemann (1755–1843), are German physicians.

While biological studies flourished in Göttingen through Haller and Blumenbach, mathematical and physical, historical, juristic, and philological scholarship also found there the most brilliant representation. Lichtenberg (1744–99) had there his model laboratory for physics and his theories of electricity became victorious. Tobias Mayer (1723–62) worked out there his famous catalogue of zodiacal stars and Kaestner (1719–1800) attracted the mathematicians. All three stand as foremost representatives of the inorganic sciences of the time; yet Euler (1707–83), whom Frederick the Great called to Berlin, was perhaps more original in his numerous works dealing with mechanics and dioptrics, integral calculus and astronomy. Chemistry which began to demolish the old phlogiston theory was largely enriched by the comprehensive analyses of Scheele (1742–86), by Klaproth and others, and Richter (1762–1807) became the founder of chemical stoechiometry.

The classical philology of the 18th century also took, in Germany, a new turn. It was the time of the great literary movement in which every mind was directed toward the beauty of art. The new aim for the student of antiquity was to join the interest in classical fine arts with the interest in the writings and to approach the literature of antiquity with the attitude of æsthetic appreciation. Gesner (1691–1761) had revived the Greek studies throughout Germany; his Göttingen successor, Heyne (1729–1812), who edited Virgil, Homer, and Pindar, and explained Greek mythology, did much to give classical studies the æsthetic interest. The whole revival was known as the neo-humanistic movement. The greatest exponent was Heyne's pupil, F. A. Wolf (1759–1817), whose 'Prolegomena in Homerum' were epoch-making. With Wolf, the one-sided æsthetic attitude goes over into an enthusiastic interest for the whole of Greek life, its religion and art, its politics and history. The study of antiquity became for him a system of 24 different disciplines.

3. While thus the spirit of enlightenment in philosophy and natural sciences, in jurisprudence and theology, and the æsthetic spirit in literature, history and philology gave interest and value to the intellectual life of Germany, the greatest emanation of the German genius had prepared itself. In the year 1781 appeared the first of the three great critiques of Immanuel Kant (1724–1804). Kant's critique of pure reason, critique of practical reason and critique of judgment, represent the most essential progress of human thought since Plato and Aristotle. The preceding rationalism which sought knowledge of metaphysical reality through reason, and the preceding empiricism which sought knowledge from the impressions on the senses, were equally superseded by Kant's "criticism," which proves that knowledge does not mean a reproduction of an independent reality, but a reconstruction of objective data by the subjective categories of perception and understanding. Knowledge is thus not concerned with a metaphysical reality; but we belong to the world of reality as free subjects of will who are determined not by the causalty of phenomena, but by duties. This gigantic reorganization of human knowledge and morality inspired the leaders of German culture; in Schiller it came into live contact with the great literary movement of Germany.

In the philosophical discussion of Kantian philosophy Jacobi, Beck, Maimon, Reinhold, Fries, represent most different attitudes, yet none of them suggests real progress. But Kant's system demanded further development; the subjective factor of his system was not really connected with the objective factor. The genius of Fichte (1762–1814) created a system whose ethical idealism made the object itself dependent upon the will-act of the subject, while Herbart (1776–1841) moved in the opposite direction, developing out of Kant's objective factor a realistic system which gave impulses to modern psychology. Directly from Kant, too, is derived Schopenhauer's (1788–1860) voluntaristic system of pessimism, which combines Kant's doctrine of the categories with Platonism and Buddhism. Schleiermacher (1768–1834) finally seeks to harmonize the ideal and the real factor in the interest of ethics and religion. It was Fichte's system which showed the direction for the further movement. The life of nature had been neglected in Kant and Fichte; as soon as it becomes a factor in philosophic thought, ethical idealism turns into the objective idealism of Schelling (1775–1854), and ultimately into the absolute idealism of Hegel (1770–1831), which understands nature and mind as the logically necessary expression of the Absolute. At every stage idealism exercised influence on the intellectual life of the time. From Fichte started the ethical regeneration of Prussia, expressed in the foundation of the University of Berlin (1810), and the romantic movement of Schlegel and Novalis. Schelling, on the other hand, influenced most deeply the naturalists, men like Oken, Oersted, Carus, Ness von Esenbeck, and many others who brought natural science itself under the categories of Schelling's system of identity, but philosophers like Krause and Solger also followed him. The strongest philosophical influence, however, resulted from the Hegelian system which, at about 1830, entirely controlled the academic philosophy of Prussia. But the triumph of Hegelianism meant an overtension of purely speculative thought, the maximum distance of theoretical and metaphysical construction from the facts of observation. This neglect of experience demanded a necessary reaction against speculation; the breakdown of metaphysical one-sidedness was disastrous. In the fourth decade of the 19th century the defeat of philosophy seemed complete and it meant the triumph of natural science as against metaphysics, of analysis as against synthesis, of realism and materialism as against idealism, of technique as against art, of specialization as against generalization. This naturalistic reaction filled the larger part of the 19th century in all civilized countries and brought to them the manifold discoveries and inventions which seem most characteristic of the time. Only at the end of the 19th century does the pendulum seem to begin again its backward swing with a new awakening of the idealistic spirit and deeper philosophical interests as reaction against the philosophical superficiality and incoherency of mere specialistic science.

4. In every new phase of this 19th century movement German scholars have taken the leadership. The deep philosophical longing of the German soul had created the unique movement which led from Kant to Hegel, but when the opposite tendency of the newer time demanded the patient work of the specialist, it was the world-known German thoroughness which won the laurels for the German laboratory experiment and naturalistic research and historical investigation.

Of course this specializing work had not waited for the downfall of philosophy; it took its rise in the work which we traced through the period of enlightenment in the 18th century. And further, the emphasis on specialization does not mean that the scientific life of Germany lacks in the 19th century great central figures, scholars with broad synthetic energy: the geographer Alexander von Humboldt, the physicist Helmholtz, the pathologist Virchow, the historians Ranke and Mommsen, are certainly not specialists in the narrow sense of the word. A short survey of the different fields indicates the abundance of brilliant thinkers who were grouped about such leaders. We may begin with mathematics and the inorganic natural sciences, then turn to the organic sciences and medicine, then to the historical and philological, economical and juristic fields, finally to the theological and philosophical.

For mathematics the first place belongs to Gauss (1777–1855) and after him the chief advance came through Jacobi, Dirichlet, Riemann, Kronecker, Weierstrass and others; yet the mathematical achievements were always blending with the works of physicists and astronomers — as not a small part of the mathematical progress belongs to naturalists like Kirchoff, Helmholtz, Enck, Clausius, etc.

Gauss gave the strongest theoretical impulse also to astronomy, while Bessel (1784–1846) may be considered the founder of the practical astronomy of the century. Most influential for the theory were Hansen and Encke and their followers, Bruhns, Argelander, Brünnow, Auwers, etc. Here belongs also as a special triumph of German thought, the discovery of spectral analysis by Kirchoff and Bunsen, applied by Zöllner and others.

In physics the turning point of the century lies at its middle when Helmholtz (1821–94) and independently R. Mayer (1841–78) formulated the law of the conservation of energy. In the first half of the century the best work in physics was done outside of Germany; among the Germans Ohm excelled (1787–1854) with his fundamental theories of galvanism; the brothers Weber, Poggendorff, Lenz, belong to the same period. The influence of Helmholtz is felt not only in the theory of energy, but in the whole field of mechanics, optics, and acoustics, besides physiology and psychology. The next and last climax is reached by Hertz through his study of the propagation of electric waves. Important too are the thermodynamics of Clausius, the electrolytic work of Hittorf, and most recently the discoveries of Röntgen concerning cathode rays.

In chemistry the decisive step was the foundation of a chemical university laboratory in Giessen by Justus Liebig (1803–73), the greatest chemist of his time, who revolutionized organic chemistry and whose researches became invaluable for agriculture, pharmacy, the preparation of food, etc. Out of his school came influential chemists of all nationalities; in Germany itself especially, Kekule, Hofmann, Fehling, Kopp, Bayer, V. Meyer. Other centres of chemical ideas were the laboratories of Wöhler in Göttingen, of Bunsen in Heidelberg, of Mitscherlich and Rose in Berlin. The theory of atomistic combination was furthered by the antagonists Kekule and Kolbe, stereochemistry by Wislicenus and von Meyer, inorganic analysis by Wöhler, Winkler, Kirchoff, Bunsen, whose epoch-making spectral analysis has been mentioned before. The first organic synthesis is the famous work of Wöhler in 1829. It opened in long series of synthetic successes of which not a few became technically important, as those of Fettig, Gräbe, Hofmann, Fischer. Practical gain also to pharmacy came directly from German chemistry; chlorohydrate and chloroform, salicyl and antipyrin, etc., are products of German laboratories. The incomparable position of German chemical industry is the immediate outcome of the wonderful development of chemical science in German universities and technological institutes.

The independent growth of physical chemistry prepared by Kopp, Bunsen, Wiedemann, became most significant in recent times through Ostwald, Van't Hoff, Nernst, etc. Mineralogy and crystallography connects its development in Germany in first line with the name of C. S. Weiss in Berlin, Neumann in Königsberg, Hessel in Marburg, Rose in Berlin, von Rath in Bonn, Zirkel in Leipzig, etc.

Geology became a science in Germany through A. G. Werner, in Freiberg, at the beginning of the century, and L. v. Buch developed the doctrine of the slow upheaval of continents; his geological map of Germany appeared in 1824. But greater was their pupil, Alexander von Humboldt (1769–1859), the most comprehensive German naturalist of his time. His studies in South and Central America and in Asia, his incomparable richness of observation in all fields of descriptive science, his unifying apperception of nature, as expressed in his 'Kosmos,' make him the most imposing and most sympathetic figure in the German science of the first half of the last century.

Inasmuch as Humboldt's geography was essentially physical, it seemed opposed to the historical-geographical interest. A synthesis of both tendencies characterizes the work of Carl Ritter (1779–1859), whom his time considered the founder of scientific geography. His contributions to theoretical geography found a brilliant continuation through Peschel, Kiepert, Gerland, Ratzel, and others. In the meantime, practical geography was stimulated by Richthofen, Peschuel-Lösche, etc. Well known are the maps of Petermann, Perthes, etc.

Geography may connect the inorganic with the organic world. To begin with botany, the first decades of the last century belonged to plant anatomy; the highest point was reached by H. v. Mohl. Then came, about 1840, the turn to the genetic study and the development of plant histology. The epoch-making discoveries of Schleiden (1804–81) and of Nägeli showed the way. The morphologic work, partly with histological, partly with phylogenetic interest, was continued by Schwann, Hofmeister, Pringsheim, DeBary, Strasburger, Solms, etc. The fundaments of plant physiology were laid by Julius Sachs, whose 'Experimental Physiology of Plants' appeared in 1865. Pfeffer, Klebs, Stahl, etc., followed.

In zoology the century began with systematic interests, but turned soon to morphological ones and came on this path to the brilliant achievements connected with the names of Köllicker and Siebold, Ehrenberg and Max Schultze, Leydig, Leuckart, and Hertwig. The leader in comparative anatomy, which started in Germany with Meckel, the "German Cuvier," was Gegenbaür; the prophet of Darwinism became Hæckel, and the most influential critics of Darwinism, Wagner and Weismann.

The progress of human anatomy links itself partly with the same names which became influential in zoology; at the middle of the century the anatomists Henle, Hyrtl, Baer, and Köllicker stand as the acknowledged leaders. His, Hertwig, Roux, and Waldeyer represent the later decades. Yet, it is characteristic for the German mind, that its most brilliant achievements belonged to physiology rather than to anatomy. No field, indeed, has greater names than physiology, with Joh. v. Müller and Helmholtz. Rudolphi and Burdach, whose large physiology appeared in 1832, made physiology at home in Germany, and soon came the master, Johannes v. Müller (1801–58). His influence — it is said that he wrote 16,000 printed pages — was deeply felt throughout physiology, embryology, anatomy, and zoology; most popular is, perhaps, his doctrine of the specific energy of the senses. Among his many important pupils none was greater than H. v. Helmholtz (1821–94), whose invention of the ophthalmoscope (1851) created the new ophthalmology. His physiological optics and his book on tone sensations are still authoritative to-day. Dubois-Reymond's investigations of electrophysiological phenomena, and Ludwig's analysis of the functions of the heart opened new ways also, and so did Voit, Pettenkofer, Hering, Brücke, Pflüger, etc., in various directions.

In the development of pathology the central figure is Rudolf Virchow (1821–1902), whose cellular pathology revolutionized the theory of disease and led it to the heights of modern histology. His pupils, Cohnheim and Recklinghausen, continued his proof that the organic laws working in disease are identical with those of the normal organism. A new movement came in with bacteriology; the discovery of the tubercle bacillus (1882) through R. Koch and his investigations of anthrax, turned his attention from the diseased cell to the microscopical causes of the diseases. From bacteriology pathology finally turned to chemistry, studying the substances produced by the diseased tissues. This led to the theory of antitoxins and to Behring's discovery of the antitoxin treatment of diphtheria. Practical medicine was in the meantime led by men like Frerichs and Erb, Langenbeck and Billroth, Graefe and Griesinger.

5. In the world of mental sciences it is philology whose specialistic ramification in the 19th century is similar to the work of the naturalists. The classical philologians led the way, and the grammatical scholar Hermann deepened the linguistic interest in the classical authors; his opponents, Boeck, Welcker, O. Müller, and others stood for the wider view of F. A. Wolf, taking philology in its fullest meaning. Zeller, Niebuhr, Droysen, Mommsen, Curtius gave new life to the thought and politics of the old nations, and Lachmann, Haupt, Ritschl and others interpreted their authors.

Germanic philology is entirely a product of the 19th century. The romanticists, Schlegel and Tieck, stimulated interest in it, but it became a real branch of scholarship through Lachmann, Benecke, and especially the brothers Jacob Grimm (1785–1863) and Wilhelm Grimm (1786–1859), whose studies in the history of the German language and literature became of paramount importance. As to other languages German scholarship has contributed much to Romanic, English, Slavic, but most of all to Oriental philology in the widest sense of the word, and through Bopp, Pott, Benfey, W. v. Humboldt, Schleicher, etc., is the comparative science of language essentially a German creation.

History, too, took the stamp of the specializing scholarship of the century. An overwhelming mass of material has been gathered by the research of the German historical schools. Typical are the 'Monumenta Germaniæ historica.' But the pride of this field of German scholarship is the noble line of great historical writers. Niebuhr (1776–1831) gave to the world a perfect reconstruction of early Roman history, and Mommsen (1817–1903) equally eminent as historian, jurist, and philologist, gave in his Roman history the German masterpiece of classical history writing. Yet the greatest figure of this group was Leopold Ranke (1795–1886), whose works deal with the popes, with Prussia, England, France, especially in the 16th and 17th centuries, and in the last years of his life with world history; they are famous alike for their style and composition, for their richness of material, and for their objective presentation. Schlosser and Gervinus went their own way; Sybel and Waitz, Giesebrecht and Treitschke, however, were deeply under Ranke's influence.

The economic life of the social community was seen at the beginning of the century through the eyes of France and England. The abstract theory of economy with its individualistic tendency controlled the first decades; of this the work of Rau is typical. With the year 1840 begins the growing reaction. The historical relativistic view is developed by Roscher, Kries, and others, and List, in his 'National System,' Rodbertus, in his 'Social Letters,' Marx, in his 'Kapital,' led the attack of collectivism against the abstract individualistic theory. Brentano, Knapp, and Schmoller turned the attention to the objective history of economic conditions.

The legal life of the community and the theory of law was the object of not less intense discussion. Among the leaders of the century Savigny, Windscheid, and Jhering may be mentioned for Roman Law, Eichhorn and Grimm for German Law, Mohl and Bluntschli for State Law, Feuerbach and Mittermaier for Criminal Law, Thibaut and Dernburg for Private Law, etc.

In the field of religion the naturalistic tendency of this post-idealistic period demanded, first of all, historical criticism, and yet positive theology was not idle. In the study of the Old Testament most fundamental research work was done by Hengstenberg, Delitzch, and Hofmann; in the study of the New Testament by F. C. Baur, the founder of the school of Tübingen, D. F. Strauss, and in sharp contrast to them, Ritschl and Weizsäcker; in the study of Church history by Planck, Neander, Ritschl, and Harnack; in the study of Systematic Theology by Schleiermacher, Rothe, Lipsius, Nitzsch, Ritschl.

And finally, philosophy. The period which we have just characterized by the abundance of its specializing work began with the downfall of Hegelianism. The age became indifferent to real philosophy and substituted either an uncritical materialism with Büchner, Vogt, or the history of philosophy which naturally became the domain of Hegelians like Erdmann, Kuno Fischer, etc., or developed a specialistic study of empirical psychology. In the latter field Germany founded, through Fechner and Wundt, the new science of experimental psychology. In the last two decades of the century new interest in real philosophy has set in, partly in the midst of the special sciences, as mathematics, physics, history, etc., where a disappointment in mere fact-gathering has everywhere led to the deeper problems of principle, partly in pure philosophy. This new idealistic movement has grown rapidly; logical, ethical, metaphysical, æsthetical discussions come again more and more to the foreground, welcomed by the empirical sciences which held them in contempt for half a century. And thus it can be said that with the beginning of the 20th century the anti-idealistic specialistic movement, which began in the third decade of the last century, has come to an end and a new synthetic idealistic tendency appears to-day throughout German science and thought.

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10. HISTORY OF GERMAN RELIGION. The earliest religious ideas and forms of worship among the ancient Germans have been the object of scientific study since the epoch-making work of Jakob Grimm (q.v.) (d. 1863), but so far without such generally accepted results as give confidence in their correctness and completeness. The Germans appear to have shared the religious conceptions of the great "Indo-European" family, to which, in the absence of entire certainty as to their origin, we continue to assign them. Their religion thus presents, at the time when they first enter into the field of historical inquiry, the aspect of a well-developed mythology.

Beginning presumably with a simple reverence and dread for the beneficial and harmful forces of outward Nature, they had advanced with a more highly developed social organization to a more elaborate system of personal deities. Three central ideas seem to have been common to the several tribal groups into which the people thought of themselves as divided. The god of War (Thiu, Thiwas), the god of the Storm (Wotan, Odin), and a goddess of Fertility (Freya) appear in a variety of forms and have their history of local adherence, of diffusion and of adoption. These figures are distinct enough to have left their names on days of the week and to have attracted the attention of Roman observers. In the descriptions of Cæsar and Tacitus they appear respectively as Mars, Hercules, and Isis, so that we may be quite sure that at the beginning of our era these principal figures had taken on a fairly definite shape. They were accompanied by a world of secondary mythological creations, spirits of the air, the forest, and the stream, giants, dwarfs, and other half-human personalities. Later, and especially among the Teutons of the far north, there was added the conception of a cosmos created out of nothing, and, as the climax of the system, appears another equally vivid notion of an ultimate cataclysm in which gods and universe alike shall be overwhelmed.

In their dealings with the unseen powers the Germans seem not to have evolved or needed any formal ritual in the hands of an organized, mediatorial priesthood. The chiefs of the family or the tribe performed the necessary sacrifices by which the favor of the gods was propitiated or their wrath averted. No theology or speculative development of these original simple ideas was ever reached. The whole system bears the marks of a fresh, vigorous and spontaneous expression of intimacy between conquering freeman and the divine governance under which they lived. The conflicts of the gods, their spacious repose in Walhalla, reflect the ideals of a race which from our earliest glimpses of it appears in a slow but steady movement upward toward higher levels of social, economic, and spiritual experience.

Thus equipped the Germanic peoples enter upon their fateful contact with the Romans. In the course of this contact, whether in the form of Roman military or commercial visits to them, or in their own military service in the Roman armies, they may have undergone a species of religious disintegration such as often accompanies profound changes of national experience. The ancient gods of the tribe could not long maintain their hold on the affections of a people whose tribal life was shattered to its foundation by the manifold reactions of the Roman culture. It was probably this weakening of the ancient ties of religion that combined with the more obvious political motives to bring about the transition to Christianity.

It is an undoubted fact that all those German tribes which left their ancient homes beyond the Rhine and the Danube and moved in mass southward and westward on to the lands of Rome had already at the time of this occupation become converted to the religion of

Christ. The process of this conversion is, however, almost entirely obscure. Among the Greek and Roman populations Christianity had made its way for three centuries, wholly by the method of individual conviction, and even during the 4th century, after the weight of imperial pressure had been added, the same process had gone on. Christianity had made its appeal to these highly developed peoples as a system of thought and as a rule of life. To the uncultured and intellectually undisciplined Germans such an appeal seems obviously impossible. They encountered Christianity long after it had entered upon its institutional stage. They met it as one of those governmental agencies by which Rome seemed to have grown great, and adopted it as a new means of greatness for themselves. Once adopted they clung to it with unshaken loyalty and gradually came to understand its spirit. Further these same peoples,— the migrating tribes in stricter sense, including the Visigoths, Ostrogoths, Burgundians, Vandals, and Lombards,— were all converted to the Arian form of Christianity, that form which was condemned by the first General Council at Nicæa (325), but which continued during the next two centuries, under various disguises, to maintain a powerful hold on Eastern speculative thought. Attempts have been made to show that this doctrinal divergence of the Germans is to be accounted for by some spiritual affinity between their mental attitude and that of the Arian agencies through which they received the new faith. It does not, however, seem likely that it is to be explained on any intellectual grounds whatever. Their conversion took place mainly from the East at a time when Arianism was dominant at Constantinople, and it was altogether in accord with their stage of religious culture that they should take what was offered them without nice discrimination. Later, long after their settlement in their respective homes on Roman soil, such of these tribes as survived changed their form of Christianity to that which had then, under the leadership of the bishops of Rome, come to be dominant in the western world. But one really striking figure emerges out of the obscurity of this period, that of Ulfila the Visigoth, whose translation of the Hebrew and Christian Scriptures from Greek into a written Gothic language which he himself invented for the purpose, remains the most important document of the conversion, precious alike to the theologian and the philologist. A copy written in silver letters upon purple parchment and known as the «Silver Codex» is in the library of the University at Upsala, Sweden.

Quite similar in motive and process, but infinitely different in result, is the conversion of those Germanic peoples who did not abandon their ancient homes, but remaining rooted there sent out branches to overspread the more or less Romanized lands of Gaul and Britain. The Anglo-Saxons, coming over into England from about 450 onward and striking upon a Christianized Keltic population not greatly superior to them in culture, early developed a race antagonism which prevented any effective reaction upon themselves. It was not until the close of the 6th century that they were visited by missionaries sent out directly from Rome by Pope Gregory I and converted to Christianity under the Roman form. Their attitude toward it seems to have been the same as that of their brethren of the lower Danube two centuries before. They accepted it at the bidding of chieftains who saw in it a means of sharing in the larger life represented to them by the name of Rome. A generation later Anglo-Saxon Christianity was undoubtedly promoted by Keltic missionary activity in the North. The Anglo-Saxons appear to have been quite uninfluenced by their Teutonic neighbors and kinsfolk across the Channel, the Franks, whose conversion had taken place almost a century before.

The elements of the story in the case of the Franks are again much the same: a heathen king (Clovis) married to a Christian Germanic wife, to whom freedom of worship has been guaranteed, a series of persuasions all based on the superiority of Christianity as a working religion and finally a dramatic event, the victory of the Frankish host over a heathen enemy, and then a tribal conversion with wholesale baptism. In the account of these events written a hundred years later by the bishop Gregory of Tours, the gods of Clovis are described in Roman terms as Jupiter, Hercules, etc., so completely had the sense of distinction among heathen religious systems disappeared from the Christian consciousness.

The decisive incident in these two northern conversions was that they were made into the fellowship of the Roman Catholic Church and thus determined for the future the religious allegiance of those two Germanic races which were destined to survive or to incorporate the rest. In the furious struggles for power among the Merovingian successors of Clovis, the Church appears as the one civilizing and humanizing agency in a society that seems to be on the verge of complete disintegration. Yet even its influence was fitful and ineffective. The Roman bishopric, involved in a life and death struggle with German Arian invaders and with the revived activity of the Eastern empire in Italy, was unable to offer to the West the unifying force it needed. The great efforts of Gregory I in this direction do not seem to have had permanent results in placing the Church of Gaul on a solid basis. It was reserved for the newly established power of the Carolingian *Majors Domus*, especially the sons of Charles Martel, about the middle of the 8th century, to reorganize the Frankish Church on the twofold foundation of national control and papal supervision.

This alliance of the Frankish state with the Roman power was strengthened by the effective work of the Anglo-Saxon Winfried, who under his Latinized name of Boniface became the active agent of both in the definite establishment of the Roman Church system in Germany. He was made first Archbishop of Mainz and was the founder of the monastery of Fulda in Hessen, long to be the most important outpost of Franco-Roman Christianity toward the still heathen Saxons and Frisians lying in the vast lowlands of the North from Rhine to Elbe.

The contemporary accounts of the long conflict of Charlemagne with the Saxons shows them at practically the same stage of civilization as were their kinsfolk in the narrative of Tacitus 700 years earlier. Still almost untouched by Roman influences, they resisted with heroic courage every attempt to impose upon them Frankish supremacy and Roman religion.

Their final defeat and incorporation into the political scheme of Charlemagne was by far the most important contribution yet made toward the upbuilding of a distinctively German Christianity. So complete was this process of assimilation that when, about a hundred years later, one of their own historians tells the story of their conquest, the tribal point of view is almost wholly forgotten in the pride of the writer over the delivery of his people from the bonds of a degrading superstition. Episcopal centres were established at Minden, Paderborn, Verden, Bremen, Osnabrück, and Halberstadt, and were henceforth maintained as bulwarks of the Church against the still rampant heathenism of Scandinavia and of the Slavic peoples beyond the Elbe. From an early day the bishoprics of Germany shared with other landholding interests the character of territorial lordships, closely identified with the soil, loyal to the vast Roman ecclesiastical system of which they formed a noteworthy part, but primarily German in character and sentiment. In the struggles for power in the 9th century among the local chiefs the support of the great bishops was indispensable, and they came out in the 10th century firmly established as the equals of the highest among the lay lords, and even superior to many of those in the wide range of their influence and the security of their landed revenues.

With the definite organization of Feudalism (q.v.), after the break-up of the Carolingian system they enter into the scheme of his newly constructed society as in some ways its most important units. Their selection is so largely influenced by the kings, whenever these chance to be men of weight, that the bishops come to be thought of as a kind of royal officials, and from this close association with temporal affairs come those often well-founded charges of worldliness which are the moving cause of the clerical reform movement of the 11th century. In this movement for the betterment of society through an increased emphasis on the ascetic life Germany took less active interest than those southern regions, notably of France, in which it originated. German monasticism had from the beginning an eminently practical character. Its work had been largely that of the pioneer in a new country, developing industry by the improvement of the land and cultivating learning in the comparative security of its protected life. On the whole we hear little of the corruption that had often led to serious outbreaks against the monastic system in the South. The leading abbacies in the houses for women as well as for men were often filled by members or intimate connections of the royal families, and such persons, as for example, the abbots of Fulda, Saint Gallen, or Reichenau, take their place alongside the bishops as feudal princes. Also their appointments, like those of the bishops, were greatly influenced by the policy of the government.

It is largely this close identification of the higher church offices with the royal power that leads to the most important struggle of the Middle Ages, the Wars of the Investiture (1075–1122). The direct issue in that long conflict was whether the German Church was to continue in its former intimate relation to the German king or was to become, through the process of the papal investiture, subject to a foreign political control. The outcome as expressed in the Concordat of Worms (1122), was in appearance a compromise based upon a division of the temporal from the spiritual powers of the episcopate; but in reality resolute kings continued afterward, as before, to bring pressure upon the higher clerical appointments. During this period it is the Holy Roman Emperor of the German Nation who stands forth as the spokesman of all temporal powers against the aggressions of his colleague in the administration of the Christian world of the West, the successor of Saint Peter. The conflict is mainly political on both sides, but political ideas were during the strict mediæval period hopelessly entangled with religious claims. The defeat of the imperial power in its efforts at aggrandizement in Italy was an advantage to the greater clerical powers in Germany as it was also to the territorial lords. From the middle of the 13th to the middle of the 14th century Germany passed through that development of almost independent principalities which were guaranteed by the Golden Bull of 1356. The control over the clergy formerly exercised by the Emperor passed thus into the hands of a group of princes with whom the central power of the Church has henceforth to deal. During the Conciliar period (1408–48) it is they who present schemes of reform for the action of the Councils at Constance and Basel, and who enter into Concordats with the Papacy of the Reaction after 1448, by which it was hoped that the ever-increasing complaints against clerical abuses might forever be laid to rest.

The agitations of the Conciliar period, however, especially in Germany, had driven men into deeper reflection upon the actual sources of authority for religious faith and practice. Three directions of thought were thus stimulated which were to move on side by side into the full current of the Protestant Reformation. These were the «evangelical,» the mystical, and the intellectual. (1) The first of these found its support in the doctrines of Wicliffe in England and Huss in Bohemia in regard to the ultimate authority of Scripture. Whatever in the thought or in the institutions of the Church was not plainly to be discovered in these original documents of Christianity was open to criticism and ought at least to be investigated. If not clearly deducible from Scripture it ought to be reformed. (2) The mystical tendency of German thought was a reaction against the overgrown institutionalism of the later mediæval Church. If it was true that the absolute comprehension of God and the complete identification of the devout soul with Him was possible through a process of individual discipline, then obviously the importance of all ecclesiastical mechanism was proportionately reduced. A formal priesthood might come to be rather an obstacle than an aid to the highest attainment of religious certainty. So, also, the most elaborate demonstrations of scholastic ingenuity were made unnecessary by this direct process of spiritual illumination. (3) The purely intellectual element came, in Germany, with the general awakening of the spirit of inquiry in the Revival of Learning. The serious northern mind turned at once away from the frivolities of mere intellectualism to its bearings upon the vital problems of religion. The principle of "common sense" found for the first time its application to religious as to other questions. Especially was this true in the field of textual study and criticism. The German Johann Reuchlin (q.v.) (d. 1522) was the first to break through the barrier of ignorant superstition that had prevented the study of Hebrew. The German Erasmus (q.v.) was the earliest scholar to approach the Greek New Testament in the true scholarly spirit.

On this threefold foundation of scriptural authority, direct spiritual insight, and the right of the human intellect to work out its own conclusions, the German Reformation built up its defense against the institutionalism of the mediæval church system. Its central doctrine, the Justification by Faith, was the expression, crude though it might be, of that harmony between the righteous soul and the order of a divinely governed universe, which had ever been the truest ideal of Christian thought. Its emphasis on the idea of individual sinfulness, exaggerated as it may now seem, was the necessary counterpoise to the equally exaggerated laxness in the existing methods of dealing with this never-ending problem. The outward success of the German Reformation was largely due to the skill with which its leaders, notably Luther (q.v.), succeeded in avoiding the logical extremes of doctrine into which a radical wing under the lead of Thomas Münzer (q.v.) and others sought to force them and also to the clear insight which led them from the first to identify their cause with that of the independent territorial princes. By this eminently conservative and constructive policy they were able to give to their work a distinctively national character, to ensure it against attack from without and thus to make it the starting point for still further advance.

Under the protection and hence to a certain extent under the direction of the several governments Lutheranism acquired during the 16th and 17th centuries a rigidity of form and of doctrine apparently no less dangerous to the free movement of human thought than the system it had supplanted. The doctrine of scriptural authority endangered by an inevitable freedom of interpretation was pushed by one wing to an extreme of literalism which could end only in self-destruction. The doctrine of the "enslaved will," strengthened by the reaction of Calvinistic predestination, was in danger of hardening into an unchristian fatalism. From these dangers Germany was saved by the growth, first, of a healthy, humane spirit, such as had always served to modify the severity of Luther's theology, and second, of a new philosophy or method of thought, which gave an ever-widening scope to the exercise of plain human reason. Luther himself had indeed laid the foundations deeper and broader than he knew when he had declared that he could be convinced of error only by "Scripture and plain reason." If these two were to have equal rights in determining religious truth it must follow of itself that reason should be applied to the interpretation of Scripture.

This is the special service of Germany in the field of modern religious thought: to have given to the accepted doctrine of Christianity a form that might make it acceptable to the modern world. The key-note is sounded in the writings of Gotthold Ephraim Lessing (q.v.), and this the more clearly because Lessing had no formal system of philosophy to offer, but approached this subject as he did all others from the point of view of the free human spirit working on the divine mysteries in virtue of a divine element within itself. Especially he demanded in religious matters the widest possible use of the critical method, the freest investigation into the original sources, in short, the treatment of the Bible as a collection of literature produced by human means and therefore subject to the same rules of criticism as all other human productions. In so far Lessing stood on the same ground as the English Deists of the previous century and their French followers, Voltaire and the Encyclopedists; but Germany was not ready at once to give up its adherence to formal Christianity. As it had escaped the frivolity of the Renaissance, so it sought to avert the frivolity of "enlightenment." It demanded a principle of thought by which it could reconcile the right of the thinking mind with what seemed to be the essential things in the inherited religious system.

This solution is the special contribution of Immanuel Kant (q.v.) (d. 1804). Others had struggled to find an expression for the idea that our reason may accept anything that is not *above* it, provided only it be not called upon to accept anything that is *contrary* to it. Kant analyzed the nature of Reason itself and found a distinction between pure reason which could never penetrate into the supernatural and a "practical" reason to which the absolute moral law is revealed. Through this principle it became possible to give new interpretations to the formal doctrines of Christianity. The intense emphasis thus laid upon the thinking individual as the final authority could not fail, however, to produce in Germany, even among most serious thinkers a growing indifference to the formulæ of faith and to the institutions that had come to represent them. Out of this comparative indifference to formal dogmas grew the two directions of religious life and thought which have specially characterized Germany to the present day. Pietism (q.v.), the emphasis upon an overstrict personal morality as the only real condition of religious satisfaction, had already found its chief expression at the University of Halle under the teaching of Spener (q.v.) (d. 1705), and Francke (q.v.) (d. 1727). It was profoundly modified by the new philosophic impulse, but it had sunk too deep into the character of the German people to be easily removed. On the other hand Rationalism, the right of the human reason to be heard in every determination of religious truth and in every institution of the religious life, was greatly strengthened by the Kantian reconciliation.

Both these directions of thought, Pietism and Naturalism (q.v.), go back in the last analysis to the same principle of the individual as the unit of religious experience and the ultimate authority in matters of faith. German religious thought in the 19th century tried to keep its hold on both these aspects of individualism. In various organizations, notably in the Evangelical Union and the *Protestantenverein* it sought to embody the practical demands for a reformed faith that should not give up the personal and social foundations of the early Reformation. In the successive schools of theological interpretation, the "rational-supernatural" of Schleiermacher and Neander (qq.v.), the "historical" school of Tübingen (q.v.), and mediatorial school of Ritschl (q.v.), Germany has aimed to keep the balance between the extravagance of modern materialism and a relapse into an official literalism. The problem of the moment in Germany as elsewhere is to bring back a sentiment of religious obligation without sacrificing the gains of modern exact science.

Bibliography.— Grimm, J., 'Deutsche Mythologie' (4 Aufl. 1878, English transl. 1888); Simrock, K., 'Handbuch der Deutschen Mythologie' (4 Aufl. 1874); Golther, W., 'Handbuch der Germanischen Mythologie' (1895); Mogk, E., 'Deutsche Mythologie' (in Paul's 'Grundriss der Deutschen Philologie' 1900); Meyer, E. H., 'Mythologie der Germanen' (1903); de la Saussaye, C., 'Religion of the Teutons' (1902); Hauck, A., 'Kirchengeschichte Deutschlands' (4 Bde. 1904); Rettberg, F. W., 'Kirchengeschichte Deutschlands' (2 Bde. 1848); Michael, Emil, 'Geschichte des Deutschen Volkes seit dem 13n Jahrhundert' (3 Bde. 1903); Janssen, J., 'Geschichte des Deutschen Volkes seit dem Ausgang des Mittelalters' (8 Bde. 1894, English transl., 8 vols., 1905); Ranke, L., 'Deutsche Geschichte im Zeitalter der Reformation' (4 Aufl., 6 Bde. 1868, English transl., 3 vols. 1847, 1 vol. 1905); Beard, G., 'Reformation of 16th Century' (1883); Fisher, G. P., 'The Reformation'; Bezold, F., 'Geschichte der Deutschen Reformation' (1890); Egelhaaf, G., 'Deutsche Geschichte im Zeitalter der Reformation' (2 Aufl. 1885); Baur, F. C., 'Vorlesungen über die christliche Dogmengeschichte' (3 Bde. 1867); Schwane, J., 'Dogmengeschichte' (4 Bde. 1895); Harnack, A., 'Lehrbuch der Dogmengeschichte' (3 Bde., 3'e Aufl. 1897); Dorner, J. A., 'Geschichte der Protestantischen Theologie' (1867, English transl. 1871); Pfleiderer, O., 'Development of Theology in Germany' (seit Kant, 2d ed., 1893).

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11. THE GERMAN UNIVERSITY SYSTEM. The conception of a university is, as part of the German educational system, free from all the difficulties of determination which are involved in the American usage of the word. In the United States the university means sometimes the best equipped colleges as distinguished from the poorer ones; sometimes those institutions which combine colleges and professional schools; yet at the same time many of the smallest and newest schools leading to the bachelor's degree call themselves universities, while the older and better ones keep the traditional name of college. Thus there is on the American side no sharp demarcation line, and hundreds of hardly comparable institutions may be called universities. The situation in Germany is in every respect the opposite of this. The German Empire has 21 universities which, at least in theory, all stand on exactly the same level, have uniform entrance conditions and degrees, are sharply and absolutely different from a German school or gymnasium, from the academies and technical schools and from every American institution; comparable perhaps with the four post-graduate departments plus the junior and senior classes of an institution like Harvard University.

The oldest German universities lie outside of the present German Empire, in Austria: Prague was founded in 1348 and soon after, Vienna. In the Germany of to-day none is older than Heidelberg, founded 1385. The others are, in historical order: Leipzig (1409), Rostock (1419), Griefswald (1456), Freiburg (1457), Tübingen (1477), Marburg (1527), Königsberg (1544), Jena (1558), Würzburg (1582), Giessen (1607), Kiel (1665), Halle (1694), Breslau (1702), Göttingen (1737), Erlangen (1743), Münster (1780), Berlin (1809), Bonn (1818), München (1826), Strassburg (1872). A lively agitation makes it probable that the next university will be founded in Hamburg.

Sixteen universities, some of them of great historical importance, existed for some centuries and disappeared again, as, for instance, Köln (1388–1794), Erfurt (1392–1816), Ingolstadt (1472–1800), Mainz (1477–1798), Wittenberg (1502–1817), Frankfurt a. O. (1506–1810), Helmstädt (1576–1809), Altdorf (1622–1807).

The essential features of these 21 institutions are given in the fact, firstly, that they are state institutions; secondly, that the instruction is adjusted to the professional training of the lawyer, the physician, the minister, the high school teacher and the scholar; thirdly, that the teachers are appointed for their achievements in productive scholarship; and finally, that the students are left to the complete freedom of independent young scholars. We have to consider carefully the bearing of these four features to understand the meaning of those institutions which have been throughout the whole of the 19th century the chief pride of the German nation, and have secured to German scholarship the acknowledged leadership in the civilized world.

State Institutions.— The German universities are state institutions. While in America the State has organized university life wherever private initiative has been insufficient, giving to the State universities on the whole a supplementary character, inasmuch as all the leading historical universities have been under the control of private corporations, the German nation takes for granted that the higher education is a matter for the state. This administrative dependence upon the state alone can secure the necessary uniformity in the preparation of the state employees, teachers, judges, and so on. And, on the other hand, as the state demands that its employees shall have studied a number of years in German state universities, it would be impossible to develop universities on private foundations. Germany thus represents in this respect the opposite extreme to England, while America takes a middle place. But it is not the empire which has any control of the universities. The higher education is a function of the particular states. Thus, Berlin is under the control of Prussia; Leipzig, of Saxony; Munich, of Bavaria; Heidelberg, of Baden; and so on. The state appoints the professors, determines their salaries and their functions and determines the requirements for the state examinations. All the expenses of the university, salaries and pensions, buildings and equipment, figure in the state budget, and are independent of the small fees which the students pay and which go directly to the professors whose lectures they attend. Thus the income of the instructors comes from two sources: the salary and the fees. In the case of disability of the professor, his whole salary is to be paid until his death; and in every case, the state takes care of the widow and orphans.

The state expenses for the universities have been about 30,000,000 marks for regular yearly expenses and about 6,000,000 marks every year for extraordinary expenses.

The leading personality in the governmental administration of the last two decades has been Dr. Friedrich Althoff, the eminent head of the Prussian University Department; his greatest achievement is the development of the naturalistic laboratories and of the clinical institutions.

This state character of the universities is in no way antagonistic to an extraordinary democratic freedom in these institutions. Their whole organization is in its essentials that of self-governed corporations, with powers in the hand of the professors which in many respects exceed those of the American faculties and which still show much of their origin in the free mediæval institutions of Germany. Fundamental is the right of the faculties to fill their vacancies by co-operation. Whenever a professorship is to be filled, the faculty selects three candidates and the government is bound to appoint a professor from among this number. The faculties, also, choose each year the president, the so-called rector, out of their own number. The teaching staff consists further, not only of full professors and assistant professors, but also of docents (privatdocenten) who have no salaries, but fees only, and their appointment is absolutely in the hands of the faculty. In earliest times the universities even had their own courts. This exemption from civil law has been abolished, but some disciplinary rights have still been kept up. Above all, the state has no right to interfere with the teaching of any instructor. No political pressure can be applied, and no professor can be removed from his place against his will. There is no sphere of public activity in the German Empire in which the state control is so little felt as in the university; everything is adjusted to the greatest possible freedom of thought.

Professional Faculties.— The universities are schools for professional training. They stand hereby in sharp contrast to the English and American systems. In America the law schools, medical schools, and some of the divinity schools, stood in old times on a very low level of general education. Almost anyone was admitted. And independent of these, the country had its colleges as places of highest education; these were the real universities of the land, with the aim of furnishing the highest liberal education, accessible alike to the future business man and to the professional students. In Germany the situation has been just the opposite of this since the days of the first university in the 14th century. From the beginning, each university has had its four faculties, and one of them, the faculty of arts, the latter so-called philosophical faculty, was distinctly the preparation for the three upper faculties of divinity, law and medicine. The faculty of arts had not the co-ordinated character because its professional aim of preparing school teachers had not reached an independent standing, as all teaching was done by the clergy. As soon as lay teachers were demanded, the faculty of arts, too, became professional, and the four co-ordinated faculties represented the university. Thus none but professional men have a real right to existence in the German university. The strong social effect of this historical development cannot be overlooked; it characterizes the social difference between Germany and the Anglo-Saxon countries. While in America the community of the best educated is represented by the alumni of the colleges, without reference to the question whether the way from the college leads to the court and hospital or to the bank and office, in Germany the circle of the intellectual leaders is confined to the professional men, as they alone have had reason to attend a university. Only the army ranks with them socially, while the representatives of all commercial and industrial activities take a second place, as they have no university education.

In a certain way the philosophical faculty is still to-day introductory to the three others. The students of medicine here receive the biological foundation, the students of law and divinity find here the historical, economical and philosophical work. At certain places the philosophical faculty itself has been divided into two, a naturalistic and an historical faculty. Everywhere it is at present the most developed one, with the largest number of teachers and students. The most rapid development in the last century belongs to the medical faculty, which stood far behind the law faculty a hundred years ago, while it has now far surpassed the law faculty in the number of teachers, and, for a period of years, even in the number of students.

In every faculty the foundations of the instruction are historical and theoretical. The law faculty, for instance, develops the juristic problems from a systematic point of view and leads up to the existing law through the history of Roman and German law. The practical preparation which the case system of the American law school provides is left in Germany to the so-called Referendarzeit, a period of several years which every young jurist — whether he goes into the career of the lawyer or of the judge — has to pass in the court for practical training after passing his examinations in the university. Besides the state examinations for all professions, the university offers the doctor's degree in philosophy, law and medicine, which in itself gives no right to any appointment or to any professional work, with the exception of the career of the university docent. Yet the doctor's degree is taken by most of the professional men too, as it gives by tradition the stamp of real scholarship.

The relations of the different faculties may be characterized by the following figures. In the year 1900 there were in the philosophical faculties 571 full professors, 52 associate professors, 323 assistant professors, 419 privatdocents, and 12,244 students. In the Protestant divinity faculties 110 full professors, 7 associates, 33 assistant professors, 37 docents, 2,352 students. In the Catholic divinity faculties 62 professors, 2 associate, 10 assistant professors, 10 docents, 1,546 students. In the law faculties 156 professors, 12 associates, 32 assistant professors, 40 docents, 9,259 students. In the medical faculties, 224 professors, 19 associates, 219 assistant professors, 329 docents and 7,433 students. To characterize the growth of the faculties the following figures may be added: In the year 1850 the German universities had 12,246 students (1,615 Evangel. div., 1,391 Catholic div., 4,306 law, 1,932 medicine, 3,102 philosophy). In the year 1880, 22,863 students (2,786 Evangel. div., 706 Catholic div., 5,297 law, 4,779 medicine, 9,295 philosophy). In the year 1903, 37,677 students (2,197 Evangel. div., 1,580 Catholic div., 11,747 law, 6,948 medicine, 15,205 philosophy).

The Teachers.— The teachers of the university are appointed with reference to their achievements in the advancement of knowledge. No one can understand the meaning of the German university who does not acknowledge this principle as the central energy of German academic life. In this respect Germany stands in contrast to both England and France. In England the greatest scholars, from Bacon to Darwin and Spencer, have stood outside the university life, and even the leading professors of Oxford and Cambridge have little to do with the regular teaching, which is in the hands of tutors and fellows. In France the provincial universities are professional schools whose professors are expected to be first of all teachers, while scholarly production is concentrated in the academies of Paris. In Germany alone is a complete unity of academic teacher and productive scholar demanded. It is a rare exception when an important scholar does not become a university teacher in Germany, and every university teacher without exception is expected to have added to the storehouse of the world's knowledge. America comes nearer to this German system than any European country; and yet in every American university productive scholars and reproductive scholars are mixed; the contributions to knowledge still appear as a kind of private undertaking, while the appointment refers to the teacher as teacher. This cannot be otherwise in a country where there is no sharp demarcation line between the small college, which demands school teachers, and the large university from which the mere school work ought to be banished. Germany's power to reserve all university teaching for the productive scholar thus stands in immediate relation to the sharp and uniform demarcation line, between all schools, on the one side, and the universities on the other.

This principle involves the most characteristic features of German university teaching. The university lecture is not intended as a reproduction of ready-made knowledge and the imparting of mere information is its least important function. Its essential trait is rather that which the productive scholar alone can offer, the training in scholarly methods. The gymnasium teaches facts; the university teaches a critical attitude toward all knowledge. Its vehicles are partly lectures, partly seminary exercises. The lectures are meant to be strictly personal and critical outlooks over a whole field of knowledge, independent of any special textbook. They are not to be substitutes for anything printed, but have to find their value in the contact of the student with a personality, acknowledged as an original productive scholar. The German idea is decidedly that the mastery of method which such a teacher has shown in his works will be more helpful and suggestive for the student than any brilliant rendering of second-hand knowledge. The seminaries, which have taken the place of the formal disputations of earlier centuries, lead the most advanced students to make individual efforts toward scholarly production.

This principle gives meaning also to the institution of privatdocenten. In America the young scholar has to find his academic career mostly by ascending through positions in small colleges without higher university aims, where he finds neither the means nor the time nor the advanced students for higher work. This is necessary as the large universities have merely salaried teachers whose number has, of course, to be adjusted to the demand of the instruction. The result is that the academic career is discouraging for the most vigorous minds, which see before them years of a second-rate activity. In Germany the opposite prevails. There is no limit to the number of teachers of highest class in the university. The docents have no salaries, to be sure; but their right to lecture on any specialty to advanced students is equal to that of any full professor, and no obligations are involved. It is the ideal situation for the young scholar who wants to live in the academic atmosphere from the first and who wants to devote his life to productive scholarship. A remarkable piece of scientific achievement is the only condition for his admission, however large the number of teachers in the same specialty may be. This docent system thus separates the university career from its beginning, from that of the simple teacher; confines it to productive work; and has its external advantage in the fact that out of these docents the universities choose the candidates for vacant professorships. The result is that the finest and most vigorous minds of the country are drawn into this career, and it is this personal factor above all which gives to the German university its superiority. Germany is the only country in which absolutely the best human material of the nation enters into the academic career; and the docent system is the necessary condition for this situation.

Thus the German university has no exact equivalent to the American university instructor, as the instructor has a paid position and is appointed with definite obligations as to teaching, while the docent may offer within the limits of his chosen field whatever he likes. The professor extraordinarius corresponds to the American assistant professor; the ordinarius, to the full professor. But it must be understood that in Germany both categories are appointed for life, and that the full professors only constitute the official faculty in which the administrative duties are settled. Very frequently the title of professor extraordinarius is given to docents after a series of years of valuable work. This is, then, merely a title without any professorial rights. No docent earns by his years of service any right to be advanced to a real professorship, and seniority plays no rôle in the question of advancement. The principle of inbreeding, so habitual in American universities, is strictly avoided in Germany. A constant migration of the professors is the rule, and this migration includes the German universities of Austria and Switzerland too. The faculty asks merely for the best productive scholars available, and this rejection of all claims resulting from years of service secures the eminent character of the faculty.

The Students.— The students attend the university for from three to five years for the purpose of being prepared for a profession through a critical scholarly study of its scientific basis. The attitude of the student, at least in theory, corresponds, therefore, to the scholarly character of the faculty. This is expressed by the scholarly preparation demanded as entrance condition, and is expressed further by the complete freedom of the student in every respect. As to the entrance conditions, recent years have modernized the system by giving to the more naturalistic realschule the same rights as to the classicistic gymnasium. But in no case can a student be matriculated as a full student with the right to pass state examinations who has not passed the nine years' course of one of the higher schools which presuppose a three years' course in a primary school. This 12 years' work is usually completed with the 19th year and is tested by the Abiturienten examination, which closes the school life. It is difficult to compare this point of intellectual achievement with that of American schools. On the whole, it might correspond to the beginning of the junior year in the leading American universities or to the bachelor's degree in the smaller colleges of good reputation. Those German students who have not passed this examination can enter merely as special students, so-called Hörer, without the right to pass university examinations. Foreigners cannot pass state examinations at all; but they can be matriculated and attain the doctor's degree. The American bachelor's degree is, then, usually counted as substitute for the German school examination, and years of post-graduate work in such American institutions as belong to the American Association of universities are accredited to them to a certain extent.

The time of study toward the philosophical degree is nearly always four years; for the medical degree, five years. The unit of study is not the academic year but the half year, the semester, of which the one lasts from the middle of October to the beginning of March and the other from the middle of April to the beginning of August. The right of women to be matriculated dates from recent years only, and is not uniform throughout the different parts of Germany. But every university now admits well-prepared women as special students.

The freedom of the student goes far beyond the American habit, and is not at all confined to complete freedom in the election of courses. He is not only not limited to a minimum or maximum number of courses, but the university also does not demand any kind of test for successful study in those courses. There are no course examinations, and, of course, no registration of attendance. The student is his own master and is expected to make just such use of his opportunity as befits his scholarly aims. No textbooks are prescribed in the courses; no questions are asked of the student and the final examinations have no reference to any particular courses. The majority of students change the university repeatedly, attracted by special great teachers, or by the special charms and facilities of a university town; this migration of students is one of the strongest ties which bind the states of the union together and make the German Empire an intellectual unity. But of course it works against that spirit of loyalty which binds American students toward a particular university. In the same direction works the fact that the graduates of a university have in Germany no further administrative connection with that particular place. That which binds many German students to their special alma mater for their whole life is rather their belonging to a special corps or burschenschaft or other social club.

The social life of the German student finds its characteristic expression in such club-like institutions, which have a strong intercollegiate affiliation. There is not and cannot be any class life comparable with the undergraduate departments of American universities, but these historical clubs furnish a large amount of particular academic feeling among the students. Those students who do not belong to them live, on the whole, like any private young gentleman. To live together in dormitories is unknown, and common academic occasions are somewhat rare; but the students of the fashionable corps and of dozens of other clubs, with their colored ribbons and colored caps, dominate the social life so completely that they appear to the outsider the only typical academic citizens. Their forms of social enjoyment can be understood merely historically. All the well-known excessive formalities in the regulation of beer-drinking and fencing and dueling are remainders of the 17th century and partly of earlier periods. Yet the overwhelming majority of the students spend their university years only for a limited time, or not at all, under the influence of these traditional forms of enjoyment. They are seriously working in pursuit of their earnest scholarly aims and in preparation for the difficult state examinations. Sport, beyond fencing, is on the whole little developed. It must not be forgotten that the year in the army, which is the real physical training for the German nation, falls into the university years of almost every student. Politics, too, plays a very small rôle in the academic body, while, to be sure, religious tendencies, especially Catholic and anti-Catholic movements with political character, have recently not seldom disturbed the peace of the student community.

The literature on German universities is recorded in the recent work of Erman and Horn, 'Bibliographie der deutschen Universitäten' (Leipzig 1904). The first general part contains the references for 17,363 writings; the second part, referring to the special universities, contains 21,725 titles. The best books on German universities are Lexis, W., 'Die Universitäten im Deutschen Reich' (Berlin 1904), and Paulsen, Friedrich, 'Die deutschen Universitäten und das Universitätsstudium' (Berlin 1902).

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12. GERMAN SCHOOLS. There is a somewhat perplexing puzzle which confronts the foreign students of the German educational system, especially the students of the lower and intermediary (secondary) schools. The puzzle consists in the seemingly irreconcilable conflict of two principles; i.e., the principle of uniformity, often referred to as almost regimental, expressing itself in the unity brought about by the effective measures of universal state control and the principle of almost bewildering variety and individualism within the vast range of the different schools themselves. The abundance of different types expressed by the very names of the schools existing within the frame called "System"; i.e., the occurrence of such widely different types as volk-schule, mittel-schule, realschule, oberrealschule, gymnasium, progymnasium, realgymnasium, prorealgymnasium, reform-schule, fully suggest the need of interpretation, not alone of the individual meaning of at least the principal types but also of their correlative meaning and of the part which they play within the total of the national educational system. As a general guide this definition might be descriptive: Variety in its ultimate aim which is common to all its manifold forms has been organized into Unity, while Unity finding its essential vigor in widest possible differentiation of its individual constituents should be regarded merely as a safeguarding principle guaranteeing the unhampered development of the parts.

Historical Synopsis.— The growth of the leading ideas governing the system of the German schools of to-day is best shown by way of a brief historical synopsis: As in the case of other European nations the beginnings of German public instruction must be traced back to the early functions of the Catholic Church. In the case of German public instruction there has been an early blending of the interests of the latter with the interests of the state. Although rather a short-lived experiment the rule of Carolus Magnus with its unmistakable tendency to create a uniform social order has left its trace; it has once for all times firmly established the business of public instruction as one of equal importance to both state and church. Even in the case of municipal care, rivalling as it were in course of time with state and church officials, the fundamental principle governing matters of education was never lost sight of: schools should train the children to be intelligent and moral members of the community. The sole reward of the national educator even in the earliest days has been to produce good and valuable citizens. The reign of Charlemagne has remained substantially productive and suggestive in still another direction: it has clearly pointed out the road which German public instruction was to follow, namely, in exploiting the intellectual treasures of ancient Roman civilization. Ever since the war-filled period of the migration of the peoples the Germanic people had benefited substantially from contact with other peoples; under Charlemagne, instead of chaos, a highly organized form presented itself which was readily accepted and which remained a shining light and guide for well-nigh 800 years. The higher goal was the world of the scholar whose intellectual interests throughout the greater part of the Middle Ages expressed themselves in Latin. Public education, although changing in the course of time its chief protectorate as well as many of its original features, never lost its adherence to the classical ideal. Intellectual activity of this kind has accordingly produced a rather high class of national educators and must be looked upon as one of the chief sources of high ideals governing the education of the broad masses of the people. As has been intimated, the highest authorities of church and state were early rivals. Ambition and competition above all other things led to the general acceptance of one principle of highest importance, namely, that each community should possess a school as good as that of every other.

Although the history of the German people, certainly up to the close of the Thirty Years' War, is a history of evolution in decentralization, public instruction can be said to have developed along lines of just the opposite principle. The days of the Renaissance found not only the German scholars but the German people as a whole ready and prepared to absorb the additional influx and enrichment. The immediate result in Germany, in spite of political decentralization and inefficiency, was the foundation of a veritable host of universities for which in turn the schools were obliged to offer adequate preparation. The interests of the state — whether the state be large or small, empire or duchy or municipal community — and interests of the intellectual plurality of the nation must be regarded as some of the determining factors in the history of German education. A third factor largely determining the character especially of the German schools — only indirectly the character of the universities — is the unique influence of the home and family. There can be no doubt that the youth of the German people has early been disciplined within the humble order of parental tradition toward readily accepting the validity of one golden rule, namely, that a task, no matter whether pleasant and attractive or not, must be respected for its own sake and that intellectual activity to the untrained is not a matter of choice but of duty as long as there are elders who assume the responsibility to make such a task compulsory. Based undeniably on authority, yet stimulated at the same time by an enormously suggestive environment, German schooling has been productive not so much through blind obedience but through home-made power of imagination and through home-made zeal toward learning as such.

Within the general system of the German schools, two distinct subdivisions must be treated separately: the public schools (volks-schule) and the schools of the higher order (gymnasium, realgymnasium, ober-realschule).

THE PUBLIC SCHOOLS

Average age on entering, 6								On leaving, 14	Continuation schools			
6 (VIII)	7 (VII)	8 (VI)	9 (V)	10 (IV)	11 (III)	12 (II)	13 (I)	(14)	15	16 (Time of apprenticeship)	17	(18)

Girl-schools are modelled much after either the lower or the higher schools for boys; only in very small communities there are no special schools for girls, which causes coeducation as a matter of necessity rather than of choice.

The public school (volks-schule, sometimes also called «Gemeinde-Schule») offers a curriculum to be covered in eight years of instruction, free of charge throughout the country. The number of individual classes actually established on this eight-year plan depends on the size of the local population, to some extent also on its wealth, although any marked lack of local funds — (municipal budget) — invariably means that state funds will be offered for the maintenance of a fixed minimum as regards equipment, teachers' salaries and pension. In most of the towns, even of smaller size, public schools are found with eight classes and at least one teacher to each class, while many of the schools in the country (dorf-schulen), in villages with no larger a population than 2,000, have from four to five classes and as many teachers. There are communities in rural districts with hardly more than 50 children between the age of 6 to 14. It is in such cases that the «one class — one teacher» plan is carried out throughout the entire eight years of compulsory school attendance. But even in the latter case the idea of invisible division is not given up; it calls for a highly developed method which, of course, is one of the chief objects of the teachers' training schools.

As an example of an elementary school showing the highest degree of differentiation a schedule of the public schools of Greater Berlin may be studied:

Course of Study of the Elementary Schools at Berlin.

	Lower stage			Middle stage		Upper stage		
	VIII	VII	VI	V	IV	III	II	I
Religion	3	3	3	4	4	4	4	4
German	8	7	7	6	6	6	6	6
Object lessons	2	2	2	....	....	....	....	....
History	....	....	....	2	2	2	2	3
Arithmetic	4	4	4	4	4	4	4	4
Geometry	....	....	....	....	....	3	3	3
Nat. science	....	....	....	2	2	2	2	2
Geography	....	....	....	2	2	2	2	2
Drawing	....	1	2	2	2	2	2	2
Writing	....	2	2	2	2	1	1	1
Singing	1	1	2	2	2	2	2	2
Gymnastics	2	2	2	2	2	2	2	2
Totals	20	22	24	28	28	32	32	32

In the case of girl-schools, geometry is not begun until the seventh year and there are but two periods instead of three in the classes I and II. There are instead two periods less in these classes in arithmetic, also one period less in history in the last form than in the boy-school. There are added 14 hours of instruction in sewing and needle-work, i.e., two each in the forms VI, V and IV, three in form III and four in the two upper forms.

As a selection representing average conditions the following sketch may serve to illustrate general conditions in the rural districts: The village of Badersleben, north of the Hartz Mountains and south of Brunswick (Lat. 32°, Long. 11°, i.e., a selection almost from the centre of the German Empire), formerly within the bishopric of Halberstadt, has a population of about 3,000 inhabitants, of whom about two-thirds are Protestants and one-third Roman Catholics. In this community two public schools are maintained, one for the children of the Protestants of five classes with five teachers, the other for the Catholic children accordingly smaller. In the main the village budget defrays the expenses of these schools, but the Protestant church being richly endowed in real estate is sharing heavily toward lessening the burden to the community. This has been possible on account of the co-operative spirit between the trustees of the church and the board of local aldermen. In addition to the five classes and teachers — the latter live in a settlement in separate houses surrounded by ample garden land — there is a (sixth) class for kindergarten work with a specially appointed (woman) teacher. The senior teacher (Haupt-Lehrer) is practically the director of the entire school, while the responsibility of general supervision (visitation within certain intervals, the submitting of reports to the central board of the province, etc.) rests in both instances with the local minister of the church. The minister is one of the local school board but otherwise not engaged in instructing classes beyond the annual religious preparation of the children who are to be confirmed (Konfirmanden-Unterricht). In the regular periods of instruction in religion the accent is on the historical side of the Christian religion, the chief aim being to give a fair acquaintance with the development of Jewish religion (Old Testament) and with the main events in the history of the Christian Church until the present day. Literary documents, including some of the more popular hymns, the subjects of special attention; confessional differences, although being made clear, are not to be overemphasized. A wholesome jealousy on the side of the teachers who do not wish to see religious instruction slip back into the hands of the Church is a fair guaranty for a prudent discharge of this obviously delicate duty of the German educator.

For those boys who remain in the village after leaving public school — (some of the boys enter into local apprenticeship, but most of them are farm-hands) — continuation school courses are organized by the same authorities which handle the matters of the local schools. These courses (evening classes), which are conducted by the two senior teachers, are so arranged as not to interfere with the general work during the heavy season in farming. Incidentally the largest agricultural establishment of Badersleben, the «Kloster-Gut,» a manor originally forming a part of the local settlement of the Roman Catholic Church, has produced an agricultural school of considerable standing. In it two main courses in two years are offered. The curriculum in the first place takes up the subjects which would be offered in the continuation school. Thus boys attending this school are excused from attending the latter. Secondly, the curriculum covers the elementary branches of scientific farming. A considerable part of the time is given to practical work in field and nursery. Some six to seven teachers, including the director, who preferably is the owner of the farm, constitute the teaching staff. While this school is practically self-supporting and independent of state help, it is formally endorsed by the provincial government. The granting of the "licentia docendi" in the case of appointment of the director is a matter of approval on the ground of university courses covered successfully by the applicant (generally at the agricultural department of the university of the province, in this particular case Halle /a. Saale). The school of agriculture of this German village (although having the character of a boarding school) can well be classed with the trade schools of a city. It covers the ground which continuation schools are to cover and in addition it offers a valuable training in farming. Not a few of the young men in this school are natives of the village who after graduation take up practical farming. Another school of this kind in the neighborhood within less than two hours' railroad distance is the Ackerbauschule in the city of Helmstedt, formerly a university town in the duchy of Brunswick. From this can be gathered the frequency of such schools within a section of the country of which comparatively little is known outside of Germany. This district cannot be called highly populated; it furnishes rather a fair middle between the crowded conditions of the big cities and the industrial districts and such conditions as may be found in the thinly populated provinces of the east. In each case, however, the volks-schule as a public utility of first order is expected to lay the foundation for continuation schools and trade schools, thus making education a common thing to the entire nation. While it perpetuates safely the social structure of the nation it creates a common ground from which those whose ability has been tested may rise by entering systems of the higher order.

The nine years' course of gymnasium, realgymnasium, ober-realschule, is preceded by a three years' course of vor-schule. The latter is not necessarily an organic part of the school systems to which it leads up, but for reasons of economy many municipal budgets show the maintenance only of the complete nine years' course of the gymnasium or realgymnasium or ober-realschule. In this latter case the work preparatory (preliminary) to entering the gymnasium, etc., is assigned to the lower classes of the volks-schule. Thus the principle of possible transition from volks-schule to gymnasium is firmly established at the early age of nine. Entrance into the gymnasium takes place automatically; i.e., without special examination, wherever the vor-schule has been made an organic part of the higher system. The nine classes of the latter, whether gymnasium or realgymnasium or ober-realschule, are: Sexta, Quinta, Quarta, Untertertia, Ober-tertia, Unter-sekunda, Obersekunda, Unter-prima, Ober-prima or in the customary abbreviation: VI, V, IV, UIII, OIII, UII, OII, UI, OI. (The "a" in the German word *gymn "a" sium* is pronounced like the first "a" in Albany).

The schools referred to are non-coeducational. Not all boys enter exactly at the age of nine; also, transfers owing to change of the parental home which is quite frequent in the career of governmental officials, illness and actual delay through inability to cover the course, account for the average age at the time of graduation at the end of the ninth year to be about 19½ to 20. There are two distinct goals for which the gymnasium, real-gymnasium and ober-realschule prepare: First, promotion from unter-sekunda to ober-sekunda implies that a great many branches of civil service and co-ördinated private careers are open without examination. In a nation which has practically espoused public ownership for most of its public institutions and utilities a vast range of opportunities and careers is open to the youth of the country upon having passed this first goal in the curriculum of the schools of the higher order. Careers of this kind are those in the postal service of the nation which includes all telegraph, telephone and essentially all parcel (express) service, in the railroad service of the country; to which should be added the field of electric street-car service generally under municipal control, gas and power plants being owned and run by the communities, also forestry service which is manipulated by the nation's appointees. Public instruction and, of course, the entire professional personnel of the national army and navy must be included. Intermediary positions fully establishing a livelihood much coveted are open in all these branches. While transition from careers thus entered upon into positions requiring higher degrees of training are rare, yet by no means legally excluded, the passing of the *second goal*, graduation after nine years, carries with it universal recognition for every branch of public life.

The certificate issued by these schools of the higher order upon promotion into ober-sekunda entitles the bearer to possible promotion in the reserve military forces of the nation; this meaning substantially a more rapid passing through elementary stages of military training; i.e., the shortening of the universal original one-time term from two to one year — although the final sum of time spent during obligatory terms of service in periods up to 56 days at a time fully brings the individual's contribution up to the two years' standard. This is the significance of the more popular term "einjaehrigen-zeugnis" (one-year-term-certificate). Only in schools of medium-sized cities the classes shrink noticeably in size owing to the exit after passing unter-sekunda by those who have reached the goal of the "one-year-certificate." (The advantage of classes of smaller size for carrying on instruction in the following three upper grades cannot be underestimated; the maintenance, however, of a

Age on entering, 9						On leaving, 18 (normally)		
9	10	11	12	13	14	15	16	17
VI	V	IV	U.III	O.III	U.II	O.II	U.I	O.I

greater variety of schools of the higher order in cities with greater population as well as frequent parallel classes cause the drop in enrolment after unter-sekunda to appear but slight). Moreover, the number of those who enter "merely for sake of the one-year-certificate" with no intention of pursuing the full nine years' course is very small. The very fact that all these schools of the higher order carry on instruction irrespective of a possible withdrawal after six instead of nine years of attendance eliminates all unwholesome features of drawing premature lines or of even making early distinctions which might possibly reflect harmful criticism on the intellectual capacity of the individual pupil. Whether or not a boy is entrusted to the care of a school of the higher order is chiefly a matter of parental decision almost universally guided by quality and aspiration of intellectual inheritance. Only seemingly do such motives in selection indicate limitation. The roll-call of these schools of the higher order does not merely repeat itself from generation to generation; but shows signs of spreading and progress. It is a very subtle process — slow but marked and best recorded by the substantial growth of the number of schools of this type as well as by the actual widening of the social range from which the applications for entrance are filed. This growth is not merely indicative of the general increase of the population and the accompanying growth in wealth, but it is clearly indicative of one very striking phenomenon: the transition or the progress from one stratum of national society shows itself within the time interval of one generation to the next. The greatest and most obvious addition to the class patronizing the gymnasium, realgymnasium and ober-realschule can be traced back to the very classes mentioned above as representing the clerical element within the gigantic system of the national civil service. Invariably the successful "mittlere Beamte" (official holding an intermediate position) is apt to try for his offspring some additional schooling and thereby some additional qualification securing ultimately a corresponding rise into a wider social range.

The general system, far from being regimental in any sense of exclusiveness toward those with no distinct intellectual inheritance, has rather encouraged the instincts for social rise through education and transition from the lower grades to the higher, so much so that the system has frequently been criticized for producing a surplus for which it is difficult to provide the kind of livelihood to which from the mere point of education these "new-arrivals" would be entitled. (Note the term academic proletariat in modern analysis of the country's social conditions). With the growth of industries, however, and in view of the fact that the educational requirements insisted upon even by private concerns (such as banking institutions, large farming concerns where there are sugar-refineries and chemical laboratories for the testing of seed produce, etc.) have constantly been raised, the output of graduates from the schools of the higher order has been bound more and more not to exceed the demand. It might be expected that after the heavy drain caused by the war the "surplus-problem" will have ceased to be serious. To sum up: The present system of the schools of the higher order in its essential aim to be of greatest possible service to the nation through the privileges which it grants to its graduates both by the so-called "one-year-certificate" and "the final certificate" (opening up the gates of every thinkable career, especially admission to the universities and institutes of technology), is unquestionably in a most vital co-operation with every phase of actual life of the nation; it is by no means a system for its own sake, nor hampered in any way by the weight of its own interests and tradition, however indispensable such specific interests and traditions might continue to be per se.

The gymnasium, the realgymnasium and the ober-realschulen widely differ among themselves as regards the curriculum. The chief characteristic of the gymnasium is that Latin is taught throughout the entire nine years' course; whereby a weekly total of 68 periods of instruction, approximately one hour each, in Latin (covering all classes of the school) is reached as against 49 in case of the realgymnasium. The corresponding figures in arithmetic and mathematics are: for the gymnasium 34, for the realgymnasium 42, in natural science for the gymnasium 18, for the realgymnasium 29. The third type of the schools of the higher order, the ober-realschule offers no Latin at all, but instead the curriculum contains 47 periods for French (gymnasium 20, realgymnasium 29) and 25 periods for English (gymnasium until recently only a total of six periods in the three upper classes OII, UI, OI; — which, moreover, are "optional," like Hebrew, with the same total of six periods — realgymnasium, English 18). The total for arithmetic and mathematics excels that of the realgymnasium by five periods, 47 as against 42, while in natural science the total is twice the figure of the gymnasium (18 × 2); i.e., 36 as against 29 periods in the curriculum of the realgymnasium. The sum total of all periods of instruction per week in these three types of school differs but slightly, the gymnasium having but three periods less than the other two which carry on instruction during 307 periods per week. There are approximately 280 days throughout the year during which the schools are in session. In all the larger cities the classes dissolve in the early afternoon (at 1.30 or 2 o'clock) while in smaller communities, especially in country schools, the time-sanctioned custom of Wednesday and Saturday half-holidays is still kept up. Most of these latter regulations hold also for the schools of the lower order (volksschule) and also for girls' schools of both orders. The figures given above plainly indicate that the gymnasium can safely be regarded as the chief guardian of Latin, or, if Greek be also considered (36 periods as against none at all in the curriculum of realgymnasium and ober-realschule), the gymnasium is guardian of the classics, and is carrying out distinctly the ideals of the period of Humanism (15th and 16th century). Hence, its most frequent name, the humanistic gymnasium; while the two other systems have obtained their popular name, realgymnasium and ober-realschule, on account of their carrying out the ideals which were elaborated by the philosophy of realism. They can be traced back to the very cradle of modern science, i.e., to the influence of Bacon and Descartes upon German educators (Comenius 1592–1670), and thus are by no means void of traditional values which to the superficial observer often seem to be claimed solely by the gymnasium. As a most striking example of the period of transition from the time-sanctioned type of the humanistic gymnasium to realism in the sense just described there should be mentioned the far-reaching work of the German educator, August Hermann Francke (1663–1727). A quotation from Cotton Mather may indicate the scope of hopefulness to which the educational enterprise of Francke gave rise in those days to an American: "The world begins to feel a warmth from the fire of God which thus flames the heart of Germany, beginning to extend into many regions; the whole world will ere long be sensible of it." (A.D. 1715, pamphlet 'Nuncia bona ex terra longinqua,' Boston, S. Gerrish). Originally intended to be a model asylum for orphaned children, the Francke Institution at Halle-Saale developed into a marvelous education plant representing even to-day a little world of its own from which may be studied most advantageously all the principal forms of school from volks-schule through the intermediate (six-year course) schools to at least two of the schools of the higher order (gymnasium and ober-realschule).

The passing of the gymnasium's monopoly as the only school preparing for university was inaugurated by a step of momentous importance in the history of German schools. After much discussion of the merits and demerits of the exclusive position held heretofore by the humanistic gymnasium a conference was called in December 1890, by Emperor Wilhelm II, and subsequently a new order of public instruction was issued. Among the issues placed before this conference through the personal initiative of the head of the nation were: Adaptation of instruction to the demands not only of scholarly standards but of modern needs of the people; a fair reduction of Latin, i.e., making Latin no longer compulsory and a *conditio sine quâ non* for university immatriculation — Latin composition, heretofore an ingredient part of the prima curriculum, disappeared completely — greater consideration for individual talent. A second reform, also along progressive lines, took place in 1901. The most far-reaching result of the new order has been that it extended equal recognition to gymnasium, realgymnasium, and ober-realschule. Naturally, future students of theology, classics, ancient philology, Roman law, history and philosophy would still figure largely among those who make up the roll-call of the humanistic gymnasium. There were until recently in Prussia: 341 schools of the gymnasium type, 162 of the realgymnasium type and 99 ober-realschulen. The following figures illustrate the distribution of schools of the higher order in Greater Berlin: 75 of the nine years' course, out of which about 30 are of the gymnasium type, about another 30 of the realgymnasium type and the rest ober-realschulen. The average maximum of classroom attendance in these schools is 40; there were in the state of Prussia 24.2 pupils to every teacher (university-trained teachers only) which figure differs but very slightly from the corresponding figure for the empire (24).

Closely related to gymnasium, realgymnasium and ober-realschule, and in fact constantly everging from one of the latter or from previous combinations of the latter, are the reform-schulen. The principal new departure of the reform-schools is the postponement of Latin until lower tertia (U III). There are three years of teaching which are common to all the pupils of these reform-schools after which appears plainly the character of the former familiar types, branching off, as it were, either into gymnasium, realgymnasium and realschule, or at least into two of these final forms. The Frankfort system, also that of Altona and Hanover (Leibnitz-school) are still regarded as leading types. By this time approximately 130 reform-schools should be added to the figure given above as regards schools of the higher order in Prussia, while the additional figure for the empire would be about 160. All these schools have been fully recognized and have passed the state of experimentation, although the name "reform-schule" might still suggest a state of untested novelty or even of fighting still for recognition. All these systems, so far described, consider themselves equally progressive. They carry on instruction according to the individual needs of the youth of the nation, not in any hostile competition, but, as it were, in the spirit of team-work for the sake of perpetuating their historical inheritance and with a distinct ambition to transmit as best they can the essential intellectual and spiritual values of the nation and to be a link rich in actual life between past and future of this nation.

Besides the municipal schools which to-day together with the state schools constitute the bulk of the schools of the higher order, there existed early in the Middle Ages schools of high reputation founded bv some ecclesiastical order (cloister — or monastic schools) or by a bishop, generally on the estate of a cathedral (dom- or kathedral-schule). Schul-pforta, a monastic foundation whose impressive buildings, half-way between Leipzig and Jena just north of the Thuringian hills, date back as far as the 12th century, became a model of the humanistic gymnasium during the first half of the 16th century (charter 21 May 1543), and has since remained an educational institution of highest quality. Schul-pforta, from the very beginning an endowed school, still receives its pupils after a special entrance examination (into lower tertia, there being no sexta quinta and quarta courses) and upon the recommendation of other schools in which the pupils excelled in scholarship. Other schools are the Kloterschule-Ilfeld, the Fuertenschulen Meissen and Grimma in Saxony (1520), Thomas-Schule, Leipzig, founded A.D. 1212, and the Fulda-Gymnasium, founded in the 8th century. To most of these schools even parents of modest circumstances may send their sons; their exclusiveness, which sometimes has been referred to, excludes only candidates who give little promise as to (special) excellence in scholarship. Inasmuch as many of the nation's pedagogues and head-masters graduated from these endowed schools the influence of this type of schools has not been confined to their own group merely. Apart from these forces of tradition, one great value of the *present* lies in the remoteness of most of these schools from modern city turmoil and its unavoidable disturbing effects upon city school-life; another distinct advantage is the assuredness of their time-tested environment safeguarding the perpetuation of a healthy and steady intellectual atmosphere combined with all the stimulants of a self-sufficing and often economically self-supporting community life of their own. Like elsewhere, supervision by the state is a guaranty that the needs of modern life will not be seriously neglected. (It is in school communities like that of schul-pforta, or joachimsthal, recently transferred from Berlin to Templin, where the ideals of all schools of the higher order, i.e., the training of the nation's youth toward independent instinct for research work, has been carried out most completely. In the instance of throwing the German gymnasiast and real-gymnasiast at an early age on the resources of *Lexicon* in his home-work in foreign languages, also in the instance of expecting from him invariably a sufficient analysis of at least the syntactic elements of his daily texts, we can see some essential steps toward this goal of instruction, toward the spirit of research which later on in the universities and in the institutions of technology, agriculture, etc., has to be solely depended upon). Naturally, in schools of the boarding-school type (schul-pforta) much room can be made for independent reading, especially for the development of taste for literature. Another trait which should not be overlooked in a sketch of the essential features of this German educational system is that the departmental activities of the school are deliberately brought into mutual relation. Inasmuch as there is nowhere in the curriculum of the schools a sudden breaking off, all subjects being carried into the ninth course (absence of the credit-system for preliminary or intermediate work), such bringing into correlation of the various branches of instruction is, of course, made much easier, e.g., instruction in history, which nowhere stops short of an adjoining field, comprises the entire history of Europe and the entire history of the Hellenic Age and of Rome, and in covering these fields seeks to be supplemented and aided from the realm of studies going on parallel to it and vice-versa. Geography, almost invariably in the hands of the teacher of history, is most obviously a supplementary subject of this kind, but the most extended use made in this direction of bringing out collectively the diversified values of school instruction has been composition work in the native language. A perusal of the new order for schools of the higher order issued in 1892 will show plainly the emphasis laid on this kind of concerted activity of departmental instruction. Thus, the encouragement of the spirit of research leading ultimately to an increase of what has been termed "problem-solving-ability" is a matter not of casual occurrence — though naturally conditions as well as results must vary — but it is an integral part of the school's duty toward the nation and accordingly felt as such, i.e., as equally essential a goal to be reached as would be that primary object of all teaching, namely, the imparting of information.

Organization.—With every respect which is due to tradition and habit the question must be raised: Which are the chief conditions guaranteeing the actual working of such system of schooling, in fact on what ground, in the face of so much variety in aims and forms, is the term "system" applicable? In a country which has no central bureau of education, no board ruling over college entrance requirements, in which none of the 26 federal states interferes to the slightest degree with the internal affairs of other states, such as happen to be matters of public instruction, it is indeed surprising to find an almost universal acceptance of at least the main principles which have been referred to in this article. The most exhaustive cause (explanation) is found in the leveling influence of the German university idea. All standardization is derived from the latter. This refers to the training of the nation's teaching staff as well as to the spirit in which the individual governmental authorities conceive their duty of administration, namely, as in inseparable conjunction with their duty toward all educational institutions of the nation.

Some of the chief functions of the governmental authorities are to produce the best possible conditions for the training of the teaching staff, to assist those who have obtained the "facultas docendi" in keeping in touch with the larger world of research in spite of their having entered upon the narrow routine work of school instruction. This is partly accomplished by providing scholarships at fair intervals for attending extension courses at the universities or even by giving leave of absence for a semester's sojourn in a foreign country, especially Greece, Italy, England and France. An essential function of the state is to secure for its teacher a maximum of material independence including the case of voluntary retirement. "A good-sized pension, generally 75 or 85 per cent of his regular salary, relieves him of the fear of having to spend his old age in poverty . . . he does not need to curry favor with his superiors, much less with the citizens of the community, and in case of sickness or other misfortunes he does not have to use up his strength to the point of exhaustion from fear that he may lose his position" (United States Bureau of Education, Bulletin No. 24, 1913, "A comparison of Public Education in Germany and in the United States, by George Kerschensteiner. Director of the Schools of Munich-Bavaria," page 9). Naturally a system with a teaching staff drawn from the high plane of academic aspirations must be expected to have produced at certain times teachers who felt aloof from the youth and its still undeveloped taste for learning. There is, however, a noticeable change in recent years, partly due again to the faithful carrying out of the suggestions laid down in the Regulations of 1892 mentioned above. "There is a constant decrease of the former distance between teacher and youth, and a constant increase of mutual appreciation between both teacher and youth" ('Unterrichts- und Erziehungswesen Gross-Berlins,' ed. by Wilhelm Muench, Berlin, 1912, page 109). A further task of the highest central bodies (individual federal officials) directing the educational affairs of the nation consists in the co-operation with the intermediate authorities as are for instance in Prussia the «Provincial-Schul-Kollegian» (provincial school boards), in Bavaria the «Oberste Schulrat» (supreme school council), in Württemburg the «Oberschulrat» (superior council), etc. In these committees will be found professional educators, professors of universities and institutes of technology, directors and rectors of schools and also lay representatives (as in the case of the Hamburg board). Regulations, issued by the Kultur-Ministerium of Prussia, are the result invariably of current reports crystallizing into suggestions and thus clearly emerging from the sphere of the schools themselves, i.e., not resulting from some high-handed official above but originating from below. Other determining factors are: discussion of school matters during conventions of directors (head-masters) and at the time of the debate on the educational budget in the House of Representatives (Abgeordneten-Haus). A large percentage of the departmental staff of the Kulturministerium has had a first-hand experience in school teaching and administration, thus guaranteeing a fair representation of the average needs of the schools, i.e., a reliable body of school-experts in whose midst proposed innovations are bound to receive due attention. The rules issued recently concerning the teaching of modern languages were drafted by a committee composed of the best-known modern language teachers of the country, which establishes one of the many evidences of co-operation between the government and school experts. As long as government officialdom thus adequately expresses the will of the people, i.e., through representation by experts who themselves are in close touch with the needs of the nation, a more direct participation on the side of the people in the solution of educational problems seems unnecessary. «School questions as such never come directly to the people and accordingly the people are for the most part accustomed to accept the educational program that emanates from the government» (quoted from Kerschensteiner pamphlet). The frequent quotations by foreign observers of scathing criticism by Germans themselves and offered to public discussion even by such conservative men as the late Friedrich Paulsen should only prove the wide range of public attention given to the problems of education in spite of the seeming acquiescence of the people referred to by Kerschensteiner. Matters of this kind have to be studied from a much wider angle, and the description of any national system of education will fail unless it approaches it as the natural outgrowth of national character and national needs. With tradition and the forces of growth kept alive and effective, the German system of education, especially in its most significant form, i.e., within the realm of schools of the higher order, seems to be successfully approaching the ideal of education as formulated in Commissioner P. P. Claxton's definition: «Education, to be worth while, must be broadly vocational. It must deal with citizenship. All a man does or thinks should lead to citizenship. Life and the interpretation of life must go hand in hand.»

Bibliography.—'Education in Germany,' a reprint of the article on the German educational system from Volume III of the 'Cyclopædia of Education,' edited by Paul Monroe (New York 1912); 'The Higher Girls' Schools of Prussia,' by C. Wm. Prettyman, Foreign Research Grant Report No. 1, Teachers' College, Columbia University (New York 1911); 'German Education, Past and Present,' by Friedrich Paulsen (trans. by Th. Lorenz, New York 1908).

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13. GERMAN PAINTING. The only remains of German painting during the early Middle Ages are to be found in text illustrations in old manuscripts. Much study has been given to this subject in recent years and clever deductions have been made as to the style of painting, now unhappily lost but contemporary with these illustrations. On the whole, however, the two arts are too different to permit of definite conclusions. The first historical reference to a German painter is contained in the recognition bestowed by Emperor Charles IV on Nicolaus Wurmser, in 1359. Soon after also Theoderich of Prague is mentioned. A set of religious pictures in Castle Carlstein is customarily assigned to these men. The draftsmanship is good, while the technique of painting is poor. In conception they reveal two points for which the whole of early German art is known: (1) A peculiar tenderness of thought, and (2) a close observation of some characteristic details of nature. Contemporary with these two artists working in Bohemia was Meister Wilhelm of Cologne, by all odds the strongest artistic personality of his time, of whose works only fragments remain in the city hall of Cologne. Many pictures, however, are extant by what is called his school, and all are characterized by great winsomeness. The love with which they were painted is unmistakable. In contrast with their Italian contemporaries, the German artists were little interested in studied abstract principles of technique. Perspective in general was known to them, but it never occurred to them to make the technique of the picture its main feature. On the contrary the main appeal of all German pictures was not to the intellect, but to the emotions. From this fact springs another defect noted in early German art by those familiar with the best in Italian art, namely its lack of dramatic force. The best preserved work of this period is the altar piece in the cathedral of Cologne by Meister Stephan. With the exception of this panel of the Annunciation, Meister Stephan contented himself with painting noble figures on a flat background, unconcerned about visualizing the actions which he endeavored to portray. The figures themselves are undoubtedly influenced, if not actually copied from the mystery plays (*mysterien-spiele*) which were very popular in Germany at that time. One result of this is that the characters are all humanly near to the spectator. During the 15th and 16th centuries it was not Italian art, as one would have expected, which strongly influenced German art, but the art of the Netherlands. This was due to the strong ties of race and propinquity. Nor do the extant pictures permit, as is possible in Italian art, the study of the gradual advance from early endeavors through faithful application to perfection. The transition from the half-crude pictures of the early Germans to the almost perfect work of Holbein, Dürer, and Cranach is incredibly swift, and only few intervening personalities stand out with sufficient clearness. Martin Schöngauer (1446–88) is one of them, and he has been called the first really great German painter. Although few of his pictures have been preserved his greatness is attested to by his wonderful engravings. In him the realistic tendencies of his predecessors were coupled with a delicate sense of the ideal. Hans Holbein the Elder (1460–1524), whose reputation has suffered by the fame of his younger namesake, belonged like Schöngauer to the southern German school. He was especially successful in catching convincing poses and facial expressions and being a good draftsman, painted pictures which can hold their own by the side of those of the High Renaissance in Italy. Characteristic of him was a sense of the ornamental, and a telling use of architectural forms in his pictures. His son, Hans Holbein the Younger (1497–1543) surpassed him to such an extent that the younger Holbein is justly ranked among the world's greatest painters. He had inherited from his father a clear eye for things as they are and the gift of selecting essentials. In addition he had the rare power of indicating, by never a line that overshot its mark, the spiritual attitude of his subject. This made him one of the greatest portrait painters of all times. He traveled extensively, knew the art of all countries, but remained faithful to his one great teacher, nature herself. He enjoyed great popularity in all countries and painted, among others, some of the most important personages in Great Britain. Albrecht Dürer (1471–1528) was the equal of Holbein in artistic achievement, but in everything else fundamentally different. While the latter was objective, cool and observant, Dürer was fervently imaginative. Holbein knew how to efface his own personality. The personality of Dürer, conscientious, fervent, thoughtful and inspiring, is everywhere apparent. Unlike Holbein, whose interest in nature was confined to animate nature, Dürer loved plants and rocks and water equally well. The whole world in fact was his. He visited Italy twice. After his first visit he tried to copy the exquisite beauty of line of the Florentines. After his second visit, the rich color of the Venetians had greater interest for him. He was, however, no slavish imitator, and throughout remained distinctly German. Some critics, therefore, miss in him "that largeness which seemed native to his Italian contemporaries," and find fault with "his naïve awkwardness of figure," and angularity of line. They blame him for his "German exactness," and do not know that it is this very quality which endeared him to his people. Artists after all paint for their own people, and to judge them properly one should never forget to judge also of the tastes of their contemporaries. This is especially true of the work of Lucas Cranach the Elder (1472–1553), the painter of the German Reformation; for he was a warm personal friend of Luther. He was at his best in his portraits of the great men of the Reformation and in his pictures of the Virgin Mary. He was, moreover, a man of humor and painted some splendid parodies.

Unlike the three great men just mentioned their successors were unable to continue the study of Italian art, begun by them, without becoming enslaved by it. Slavish imitation is incompatible with great achievements. In the world at large Italian art was all powerful, and Holbein, Dürer and Cranach were soon forgotten. The remarkable spectacle is therefore offered of a whole nation turning, as it were, against the achievements of its own great men and following the example of another people. The 17th and 18th centuries in German painting constitute in Germany as well as in Italy the age of the imitators. Among the best-known German painters of this period are Adam Elzheimer (1574–1620), Balthasar Denner (1685–1749), Daniel Chodwiecki (1726–1801), the painter of the period of Frederick the Great, Anton Graff (1736–1815), and the decorative painter Daniel Gran (1694–1757). Toward the end of the 18th century a reaction set in against the imitation of the Italian Renaissance and its excesses. Coinciding with a renewed interest in the classics and a renewed study of the culture of Rome and of Greece, this period is frequently called the Classical Revival. Anton Raphael Mengs (1728–79), Asmus Jacob Carstens (1754–98) and Angelica Kauffmann (1741–1807) are the best known artists of this period. The early 19th century was characterized by the same interest in the classics, and since classical art had to be studied from extant statutes, i.e., lines rather than color, the classicists laid the emphasis upon draftsmanship, and at times actually spurned color, or at best regarded it as a necessary evil. Genelli (1798–1868), Preller (1804–78), who tried to revive the ancient world in his pictures of the Odyssey, and Rottmann (1797–1850) are the chief exponents of this tendency. They painted also huge landscapes, peopling them with the heroes of antiquity, and lived altogether in an imaginary world of classical style. It was natural that a reversion of feeling should soon take place. This made itself felt even before the classical style had run its course. A double opposition rose against the classicists, first the opposition of those who believed the classicists to be of pagan spirit. These men, who loved to paint scenes from the life of Christ, are called Nazarites, were joined by those who wished to have rich colors in their paintings rather than mere line. These latter are called Romanticists, because the rich and vivid imagination of the colorist is ever ready to forsake the realities of life for the quest of romantic subjects. The best known Nazarites and Romanticists are Cornelius (1783–1867), Wilhelm von Kaulbach (1805–47), Friederich Overbeck (1789–1869), and Schnorr von Carolsfeld (1794–1872). Other good names, well known in many German households, are Rethel (1816–59), von Swind (1804–71), Ludwig Richter (1803–84), and Baron von Blomberg (1820–71). As the natural result of the conflicting art ideals of the Classicists on the one hand and the Nazarites and the Romanticists on the other hand, there was an increased interest noticeable all over Germany in the technical questions concerning art. Art schools of special prominence appeared in Düsseldorf, Munich, Berlin and Hamburg. The most famous schools frequented also by many foreigners, among them notable Americans, were those of Munich and Düsseldorf, where such well-known American artists as Duveneck, Chase, and Ennecking received their instruction. Friederich Wilhelm von Schadow (1789–1862) has been called the father of the Düsseldorf School. He succeeded Cornelius as the director of the Academy and became better known as a teacher than as an executing painter. He was the first man in Germany to lay emphasis on a sound technique and to oppose all the weight of his great influence to the erroneous notions that since the *what* of a picture was of greater importance than the *how*, the *how* mattered little. He rightly understood that without technique even the most conspicuous artistic gifts would fall short of accomplishing artistic successes. His teaching was especially needful in Germany at that time because many German painters in their eager quest for the ideas had utterly neglected the acquisition of a sound technique. Three classes of pictures were especially cultivated in Düsseldorf: Landscapes, historical and romantic incidents, genre. Andreas Achenbach (b. 1815) was well known for his landscapes; Karl Friederich Lessing (1808–80) won fame in both landscapes and historical paintings; while Ludwig Knaus (1829) gained universal popularity with his genre pictures and occasional excursions into the religious genre. Benjamin Vautier (1829–98), Wilhelm Camphausen (1818–85), and Adolf Schrödter (1805–75) are among the many other well-known artists of this school. Of the early Munich school it suffices to name Heinrich Bürkel (1802–69), H. M. von Hess (1798–1863), Christian Morgenstern (1805–67), and August Riedel (1802–83). In Hamburg Philipp Otto Runge (1777–1810) stood head and shoulders above his colleagues; while in Berlin Franz Krüger (1797–1857) became known for his portraits and pictures of horses, and Karl Eduard Blechen (1798–1840) was the first to anticipate to some extent the phases of technique which were destined to become all absorbing during the latter half of the 19th century. He alone, for instance, at that early day conceived as beautiful the motive of thin blue smoke escaping from a factory chimney into the soft air of evening. Early in the 19th century a remarkable change took place, and in common with artists the world over, the German painters had their eyes opened to the charms of color, after they, the countrymen of Holbein, had been unconscious of it for centuries. This change in Germany can be definitely traced to the influence of Belgian art, especially the works of Gallait and Bièfve, whose gorgeous use of color and realism in composition made the beholders forget their theatrical exaggeration which to-day is most apparent. The new ideas took the strongest hold in Munich, with Karl von Piloty (1826–86) as protagonist. His success in Germany was instantaneous. He was hailed as the prophet of a new art, and in their enthusiasm his contemporaries overlooked the fact that his figures were often posed for effect and that he frequently forgot the truth of actual occurrences. Hans Makart (1840–84) was Piloty's most famous pupil. He and his art has been succinctly described as follows: «Surrounded with wealth and luxury, and worshipped almost like a god by his contemporaries, he poured forth with incredible velocity the most sensuously beautiful symphonies of color that had issued from the brush of an artist. For *values* in the modern sense of the word he had no eye. The slow and thoughtful art of Whistler he would not have understood. His colors were many and rich; they were meant to win admiration by storm, and had no message for those who love to think and dream over a picture. Makart died a young man, rushing through life, a meteor on the art heaven of Germany.» To a certain extent Makart was an individualist, which permits one to group him with the other great German individualists, Böcklin, Feuerbach, Klinger, and Marées. These four great men are alike only in their general attitude toward art. They hated impressionism —«transcribing nature as you pass along»— and believed that «art is a speech of emotions. Where words fail, art begins.» Anselm Feuerbach (1829–80) preferred the antique, but unlike the classicists he based his art on emotional rather than intellectual studies. His masterpiece is a picture of Iphigenia —«her yearning soul in search of Greece and home.» Here the soberness of his style is in perfect harmony with the simplicity of his subject. His very soberness, however, prevented him from winning the success which he so richly deserved, and his reputation is posthumous. In this respect Arnold Böcklin (1827–1901), a native Swiss, was far more fortunate; for he lived to see himself acclaimed by admiring nations as the greatest artist of all. His shortcomings, due in part to his disregard of the correct anatomy of the human body, and often hasty drawing, were forgotten over the sensuous beauty and rich imagery of his compositions. His pictures are fairy tales, and Germany has ever been the home of such tales. This accounts for his enormous popularity. Trees, figures and poses, which in themselves may have been unreal, become real in the setting Böcklin gave them. Max Klinger (b. 1857) is the youngest and most versatile of this group of artists, and is as well known as a sculptor as a painter. Unlike the others he takes pleasure in solving technical problems, and often sets himself tasks which by their stupendousness would frighten lesser men. His portrait of Beethoven, while not faultless, is the most gorgeous attempt at portraying superhuman qualities ever made. Unlike Klinger, Hans von Marées (1837–87) refuses to freight his figures with the depths of thought. On the contrary, it has been said of his graceful and correctly modeled figures that «they mean nothing, are not intended to mean anything, and are content with merely existing.» Their very existence, however, generally nude in simple landscapes fills the beholder with an inexpressible delight, if for no other reason than that «a thing of beauty is a joy forever.» Because of his great accuracy in draftsmanship one may be tempted to claim Marées as one of the so-called Realists, from whom choice of subject rather than technique differentiates him. The pioneer Realist of Germany, if not of the world, and certainly an acknowledged master everywhere, was Wilhelm Leibl (1846–1900). He held that life properly studied is more interesting than dreams about it, and confined himself to observing and accurately transcribing life. To be successful such an art needs a masterful technique, and this Leibl possessed as few men before him or after him. There are, however, limitations to the art of painting in so far as it is capable of accurately reproducing life, and these limitations are the limitations of Leibl. Judging by his art he never wished anything greater nor aspired to anything higher than what could be clearly perceived by the sense of sight and be accurately reproduced with the colors on the artist's palet. A greater man than Leibl was Adolf von Menzel (1815–1904), who was one of the most versatile of artists. Realist, to a certain extent he was at the same time the first impressionist of all, for long before the famous Frenchmen became interested in the play of light and what has been called «*values*,» he had grown interested in and solved many of the difficult problems of light and shade. In one of his most famous pictures, 'The Factory Forge,' he brought order out of a seemingly hopeless chaos, and proved himself a technician second to none. Among the many portrait painters of the second half of the 19th century by far the most famous is Franz von Lenbach (1836), whose 'Bismarck,' 'Moltke,' and 'Liszt' are known the world over as among the strongest portraits ever penned. He was less successful in the portraiture of women, having to yield the palm in this field to Friederich August von Kaulbach (b. 1850). Well known in Germany, although of a lesser international reputation, are Franz Defregger (b. 1835), who delights in pictures of the Tyrolean peasant life; Eduard von Gebhardt (b. 1838) whose religious pictures can be seen in many households; and Munkácsy, whose real name was Michael Lieb (1846–1900), whose pictures displayed great pathos and glowed in rich colors. He was a native of Hungary. The «Open Air Art,» which was all prevalent in France during the latter half of the 19th century, found its chief exponent in Germany in Max Liebermann (b. 1849), and in a long list of artists, generally grouped together as «Secessionists.» It is undeniable that this «Open Air» style gave an impetus to art and to individuality in art unlike anything that had preceded it, and that it created an interest in painting in the public mind which was most stimulating and helpful to the artists themselves. The end of the 19th century, therefore, and the early part of the 20th saw a revival of art in Germany, and a wealth of talent, which only a later generation will be able to judge and classify according to its desert. Scarbina, Stuck, Thoma, Uhde, Leistikow, Mackensen, Modersohn, Vogeler, Pepino, Fritz Overbeck are only some of the names which it seems certain will survive from the great number of executing artists busy in almost every corner of Germany.

Bibliography.— Förster, 'Geschichte der deutschen Kunst'; Knackfuss, H., Zimmermann, Max, Gg., and Gensel, W., 'Allegemeine Kunstgeschichte' (Leipzig 1903); von Mach, E., 'Outlines of the History of Painting' (1906); Muther, R., 'History of Modern Painting' (1907); 'Die Deutsche Jahrhundert-Austellung Berlin 1906' (München 1906).

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14. GERMAN SCULPTURE. German sculpture as an independent art appears for the first time during the 11th century in the shape of small statuettes and reliefs, or in the decoration of large bronze work, such as the Bronze Column of Hildesheim, surrounded by a sculptural frieze, or the entrance gates of the cathedrals of Hildesheim, Augsburg and elsewhere. The style of all these figures is crude in the extreme. The heads are disproportionately large, the eyes staring, and the bodies exaggerated, which makes them at the same time heavy and weak. It almost seems as if sculpture was resorted to, not because there were sculptors in Germany who had a message to deliver, but because it had become the fashion in other parts of the world to have sculptured decoration. This state of affairs does not materially alter, although there were occasionally better works created, until the religious enthusiasm which culminated in the Romanesque style of architecture, kindled also the plastic genius of the people. The earliest fruit of the new spirit has survived in the magnificent sculptures of the Externsteinen on the northeast slope of the Teutoburg Forest.

The Externsteinen is a group of sandstone cliffs the largest of which rise like giant teeth to a height of from 100 to 150 feet above the parklike surrounding. Steps have been cut in two of them, and from their top a magnificent view is to be had. In the westerly of these two «*teeth*» a grotto has been cut. A Latin inscription here of the year 1115 states that Bishop Heinrich of Paderborn dedicated the grotto as a funeral chapel. At the entrance a large relief, about 16 feet high by 11 feet wide, has been cut in the face of the cliff, representing the descent from the cross, with God the Father above and Adam and Eve below. The figures have suffered much by the ravages of the weather, but the truly artistic grouping and the sincerity of the whole conception are unmistakable. The very style appears to be demanded and to be determined by the location of the monument. This remained a characteristic of all German sculpture of the Middle Ages. Roughly speaking, it did not exist for itself alone, but merely in connection with architecture. Its early uncouthness and ignorance of true form, however, soon disappeared, and as early as the first part of the 13th century real life permeated the works of German sculpture which had dedicated itself to the service and to the embellishment of monumental structures. The first notable achievements, of which we know, belong to the Saxon school, and of these the most famous is the so-called golden gate of the cathedral of Freiberg. «Golden» only figuratively in the sense of valuable, for the figures are all cut out of ordinary stone. Almost equally as well known are the interior decorations of the cathedral of Wechselburg, the chancel and the altar, most especially the crucifix, the cathedral of Naumburg, the memorial monuments of Heinrich der Löwe and his wife in Brunswick, and the southeast portal of the cathedral of Bamberg (dating from 1250) offer other instances of this art. Bronze sculpture, with its unique demands on technique, flourished to the same extent, largely in smaller articles such as baptismal fonts and the like, but occasionally rose to such masterpieces as the Lion of Brunswick, an exact replica of which was presented some years ago by the

Duke of Brunswick to the Germanic Museum of Harvard University. Bronze doors from this period, for instance those in Gnesen, are also extant. When Gothic architecture supplanted the Romanesque style, new and rich opportunities were offered to the sculptors, and they availed themselves of them to the fullest extent. The figures became imbued with ever varying energy and vivacity, and the earlier squatness of the body gave way to a slenderness, sometimes exaggerated, but often seemingly demanded by the style of the architecture. The facial expression unfortunately overstepped not infrequently the bonds of sentiment and became sentimental or morbid. Excellent instances of the best of this Gothic sculpture can be found in Freiburg, Strassburg and Wetzlar. By the middle of the 14th century German sculpture, while still closely allied with architecture, had won its place as an independent art. No longer restricted to simple forms or ideas, it charms by the richness of its imagery and astounds by the perfection of its technique. This phase is best studied in the numerous churches of Nürnberg. In Nürnberg also is one of the earliest examples of independent monumental German sculpture, in the shape of the Fountain, known even to-day as the Beautiful Fountain. It is, however, very notable that this monument also is designed according to the prevailing cathedral style of architecture, the main shaft of the Fountain representing a cathedral spire. Only gradually the complete emancipation of sculpture from the overlordship of architecture took place. The first indications of this are to be found in the funeral monuments, often of stone, but more frequently of bronze, which during the 14th century were ordered in ever larger numbers by wealthy patrons. When this took place, quite naturally the individuality of the artists began to have a freer scope, and individual artists became known in their own times, and were remembered by their works by later generations. In the hands of these individual artists, German sculpture freed itself entirely from the bonds which the subordination to the greater sister art of architecture had cast over it, and every vestige of the conventional gave way to the often passionate longing of the individual artists for unique expression. At first the best German achievements were made not in stone or in bronze, but in wood. In Swabia two men of the name of Syrlin, of Ulm, were masters in this art. Hans Decker and Veit Stoss in Nürnberg, and in the same city the unknown artist of the famous statue of The Sad Virgin, rivaled with Dill Riemenschneider of Würzburg. Among the sculptors in stone of this period Adam Krafft is best known, while in bronze sculpture the Vischer family of Nürnberg stands unsurpassed. Of this family Peter Vischer is undoubtedly the most famous. Great as were these men they were unable to have their art and the greater freedom permeating it supplant the earlier art entirely. This, it has been claimed, was due to the stonecutters' unions who were unwilling to discard their standards, instruments, and measurements based on the requirements of an earlier style. In the northern part of Germany, which is poor in stone, there were no stonecutters' unions or establishments, and it is here, therefore, where the new art, especially of wood carving, unobstructed by conservative and selfish adherence to antiquated standards, gained its supreme success. Splendid examples of this northern sculpture are to be found in the cathedral of Schleswig (Brüggemann's altar), in the Marienkirche in Lübeck, and in Calcar, Köln and Xanten. With the first forerunners of the Reformation and the consequent changes in social conditions, loosening the tyranny of the unions, in common with the tyranny in other spheres, sculpture became a free art like painting, and boldly took its place as such. Italian art was at that time all powerful in Europe, having undoubtedly achieved the greatest success of the arts of the civilized countries. It was the age of the imitators, and most of the German sculptors espoused Italian ideals with almost passionate eagerness. The only patrons of importance of the arts continued to be the princes, and at their courts unfortunately foreign artists often were preferred to the native talent. This lessened the opportunities, and where opportunities are few, art has never been able to accomplish its possible best. What this best might have been appears from the magnificent monument to Elector Moritz in Freiberg, and the still more famous monument to the Emperor Maximilian in Innsbruck. With the outbreak of the Thirty Years' War the terrible conditions of the country called a cruel halt to the progress of the art of sculpture. Faint revivals took place toward the end of the 17th century, in the north under Dutch influence, and in the south under the continued influence of Italy. Austria had suffered less by the ravages of the war than the rest of Germany. It was here, therefore, and in the neighboring Bavaria, that the revival was the earliest. Architecture again called sculpture to her service. The Gothic style had disappeared long ago, and the baroque style with its bold exaggerations of form ruled the day. This was reflected in the sister art, and while a certain grandeur of conception and joy in execution are unmistakable, still the baroque style is so alien to the taste of the early 20th century that neither the buildings nor the sculptures of this period have much of a message to bring to the people of to-day. There are exceptions, and among these Schlüter's colossal statue of the Great Elector in Berlin deserves attention. Other sculptors of equal excellence with Schlüter were Grupello in Düsseldorf, Peter Wagner, and Raphael Donner in Vienna. During the 18th century the influence of France gained ascendancy over the minds of the educated classes in Germany by leaps and bounds, and since in France at that time a shallow classicism, coupled with mannerism, prevailed, it was inevitable that the same tendencies should make themselves felt also in German sculpture. The general slavish imitation of French tastes at that time is less surprising than the occasional perseverance in sound principles of art which is shown in the art of some of the German sculptors of this time. Among them may be mentioned Alexander Trippel in Weimar, Johann Heinrich von Dannecker of Stuttgart, whose 'Ariadne' in Frankfurt-on-the-Main is justly classed among the famous statues of the world, Gottfried von Schadow and Christian Daniel Rauch, both of Berlin. The most famous statue of the latter is his 'Friederich Der Grosse' in Berlin, which unfortunately

The Gutenberg Monument, Frankfort

suffers by the small scale in which it has been executed in bronze. This design demands a heroic presentation. A promising school of portrait sculpture flourished for a time in Dresden, with Ernst Julius Hähnel (statue of Raphael) and Ernst Rietschel (statue of Lessing). Both artists successfully freed themselves from the thraldom of «mere beauty of form,» and cultivated, at least to a certain extent, a wholesome realism. The next generation followed in the same direction with the exception of Johannes Schilling (b. 1828), who was one of the best-known German classicists. Germany's war of liberation of 1813 with its consequent rise of patriotic enthusiasm filled the country with an abundance of soldiers' and other patriotic monuments, few of which rose above the mediocre. In the history of German art their only importance is the fact that they made all parts of the country familiar with sculpture, and when the general wealth and education of the country had risen, made the people desirous of having in their midst finer and better samples of the art of sculpture. This increased interest in sculpture and the greater opportunities offered by it coincided in the latter half of the 19th century with an increase in artistic ability, noticeable as well in sculpture as in architecture and painting. At the head of this new art Reinhold Begas, most prolific artist, deserves first mention. His achievements are of uneven worth. At times he rises to great heights, while in his more pretentious works, as in the Memorial Fountain to Emperor William I, he falls short of his own endeavors, however magnificent individual figures are in their conception as well as in their marvelously beautiful execution. Rudolf Siemering, also of Berlin, is known in the United States by his colossal and costly Washington Monument in Philadelphia, which, admired by some, is severely criticized by others as «a gigantic table monument showing no spontaneity.» The beauty of the individual figures, however, is acknowledged by all. Abroad he is best known for his monument in Leipzig commemorating the victorious battle there against Napoleon.

A younger man than these two, Ludwig Schwantaler was the favorite sculptor of King Ludwig II of Bavaria, the patron of Wagner, and builder of fantastically beautiful castles, fitting into the magnificent scenery of his native Bavaria. Schwantaler's sculpture, partly theatrical, partly really grand, is a product of the exotic conditions flourishing under the rule of that fantastic king. His largest and best-known work is his colossal statue 'Bavaria' in München. As a national monument this statue ranks second only to the Hermann Monument high up on the northern cliff of the Teutoburg Forest, by Ernst von Bandel, erected to commemorate the final union of the several German tribes in the new German Empire. Subject and location combine to give this monument a unique place. As a work of art, however, it is far surpassed by the ultra-modern 'Bismarck' in Hamburg, by Lederer. Raised on a bold platform, with legs apart, bare-headed, garbed in the armor of a knight, the national hero, Bismarck, stands like Roland of old, with his sword ready to protect, at all times, the empire he helped to build. Designs for the proposed Hamburg monument were submitted during the first year of the 20th century; and by a strange coincidence this very year marked also the beginning of that series of monuments erected under the auspices of the emperor in the 'Sieges-Allee' in the Tiergarten of Berlin. In strong contrast to all the models submitted in Hamburg and especially the one finally selected the Berlin statuary is quiet and refined and almost shrinks from innovations. Only its technique will indicate to future generations the date of its execution; for in later years German sculpture has shown the same mastery of technique which is characteristic of her painting. In the Chicago World's Fair Exhibition of 1893 Hundrieser's 'Sleep' was characterized as a «work of rare beauty and tenderness.» It has been acquired for the museum of Saint Louis. Max Baumbach's 'Siesta,' the statue of an obese sleeping faun, was said to be a «triumph of clever marble-cutting.» The same high praise both for conception and masterful execution was bestowed at the World's Fair in Paris in 1900 on Peter Breuer's 'Adam and Eve,' while Robert Diez's 'The Tempest' won admiration with its «whirling figures of horses and marine monsters.» While Paris, London, Rome and Saint Petersburg have become familiar through international exhibitions with the works of many modern German sculptors, America has had little opportunity to study them. The Exhibition of Contemporary German Art in the Metropolitan Museum of Fine Arts in New York, Boston and elsewhere in 1909 contained only few pieces of sculpture. Cipri Adolf Berman showed his versatility in two heads, one of which, 'Old Man's Head,' a bronze, was almost antique in conception and execution, while his beautiful marble head of a woman suggested the fanciful imagery of Rodin. Of the several portrait busts that of 'Professor Flossman' by Adolf von Hildebrand (b. 1847) was the strongest and fully explained the great reputation enjoyed by Hildebrand, the «technician,» as he has been called, «the strong man of stone,» who unlike many modern «modelers» thinks in terms of stone or bronze, and adapts his designs to his material with great success. Another excellent portrait bust was shown by Fritz Klimsch (b. 1870), while the marble bust of Pfitzner by Hugo Lederer (b. 1871), by most exquisite treatment of the surface, conveyed flesh and blood and the charm of life. Technically as beautiful but very cold rather than warm with life was the statue of a crouching mother fondling her babe, by Arthur Lewin-Funcke (b. 1866), owned by Mr. Edward D. Adams of New York. A delightful piece of work, cut in shell limestone, was the bust of 'Fräulein J. H.,' by Hans Schwegerle (b. 1882), a pupil of Hildebrand. Louis Tuaillon (b. Berlin 1862) and well known for his 'Amazon on Horseback' in Berlin, which has been called by all odds the best modern German equestrian statue, exhibited a bronze bust of Emperor Frederick III and 'A Stag,' neither of which belonged to his best works. Franz von Stuck, better known as a painter (b. 1863), was represented by three works, the most daring and skilful one of which was his 'Athlete,' a study in muscles, one might say. It is characteristic of modern German art that many men work both in painting and in sculpture.

Next to von Stuck, if not ahead of him, the best known painter-sculptor is Max Klinger (b. 1857). He has been attracted by polychrome sculpture, not in the sense of actually painting his statues as did Arthur Strasser (b. 1854) and Rudolf Maison (b. 1848), but to the extent of selecting variously tinted marbles, stones, gold and other precious materials for the several parts of his statues. His 'Beethoven' and his 'Salome' are the best-known instances of this class of his work. In any list of modern German sculptors the name «Eberhardt» deserves mention. Johann Heinrich Eberhardt (1739–1813), a sculptor of note, was the father of Konrad (1768–1859) and Franz (1767–1836). Konrad was the most important artist of these three. He spent much time in Rome, where he was almost as popular as Thorwaldsen and Canova, so long as he too followed the classical style. Later he forsook the study of the classics and under the influence of the «Nazarines» confined himself to religious sculpture, in which branch he did his best work. Serafin Eberhardt (b. 1844), although no relation of the other Eberhardt, followed in the style of Konrad. Gustav Eberlein (b. 1847) is one of the popular sculptors of the Sieges-Allee in Berlin referred to above. Although a pupil of Gustav Bläser (1813–74) whose animated statuettes are remembered, while his more pretentious equestrian statues and ideal figures are forgotten, Eberlein followed in his own work the picturesque modeling of Begas. Three distinct periods mark his work; first from 1880 to about 1888, when he was best known for his «ideal figures» and well-modeled nudes; second from about 1889 to about 1898, when the deaths of Emperor William I and Emperor Frederick III and the deaths of Bismarck and Moltcke called for large monuments throughout the empire. This is Eberlein's monumental period, and among his best monuments the 'Emperor William I' in Mannheim may be mentioned. His third period began at about 1898, when he began to be interested in «tragic» motives: 'Man's First Sin,' 'Adam with Abel's Corpse,' 'Joseph of Aramathea holding the Dead Christ,' etc. These works, while greatly admired by some for their masterly modeling, are severely criticized by others for their «theatrical poses.» Nobody, however, denies his great genius in designing monumental pieces of sculpture. Owing to his international reputation along these lines he was chosen by the authorities of Buenos Aires to design and erect a national monument of the Argentine Republic. Of other well-known names it may suffice to mention Anton Ritter von Fernkorn (1813–78), a pupil of Schwanthaler, who settled in Vienna and whose many works mark a distinct epoch in the history of sculpture in Austria; Friederich Tieck (1776–1851), whose decorations for the Schauspielhaus in Berlin and portrait busts are best known; August Kiss (1802–65), whose beautiful and daring composition of a mounted Amazon fighting a panther adorns one side of the entrance to the Old Museum of Berlin, while the 'Lion Hunter' by Albert Wolf (1814–92) adorns the other side; Friederich Drake (1805–82), whose statue of Frederick William III in the Tiergarten of Berlin is famous for its delightful reliefs on the pedestal; Fritz Schaper (b. 1841), whose admirers acclaim his 'Goethe Monument' as the best of the many erected in Germany; Theodor Kalide (1801–63), the creator of the first modern statue of a Bacchante, full of life and daring; Adolf Donndorf, a pupil of Rietschel and popular sculptor of Bismarck busts; Viktor Tilgner (1844–96), the «father of realistic sculpture in Austria»; Kaspar Zumbusch (b. 1830), whose 'Maria Theresia' and 'Field Marshal Radetzky' decorate Vienna; Edmund Hellmer (b. 1850), whose Goethe Monument is likewise in Vienna; Wilhelm Ruemann (b. 1850), famous for the realistic aspect of life of his nudes; and Erich Hösel (b. 1869) whose 'Hun Woman' represents a primitive woman crouching on a horse while a wild storm is sweeping over both her and the horse. The spirit of the statue is akin to the best of the figures of Indians by Dallin and other American artists. Modern German sculpture as a whole deserves praise for masterful technique. This it shares in common with the sculpture of France, America and Italy. In the choice of their subjects, however, the German sculptors are unique, for while the conservatism of most art-loving modern nations limits their sculptors in the range of their subjects, modern Germany has given her artists *carte blanche*. Every exhibition is full of new subjects, treated in individual and often daring fashion. Among this output there is undoubtedly much which is bizarre and needs must be of short life. But there is also much which is great, because it is the true and unhampered expression of what the artist has dreamed or felt or seen.

Consult Kraus, 'Real-Encyclopædie der christlichen Altertümer'; Bode, 'Geschichte der deutschen Plastik'; Lübke, 'Geschichte der deutschen Kunst'; Reber, 'Geschichte der neueren deutschen Kunst.'

Edmund von Mach,
Author of 'Outlines of the History of Painting'; 'The Art of Painting in the Nineteenth Century'; 'Greek Sculpture, Its Spirit and Principles.'

15. GERMAN ARCHITECTURE. When the Germanic races came in contact with Rome as conquerors German art was born. While Rome had been victorious on the battlefield her higher civilization and her art had been scornfully rejected by the people she had made subject to her rule. There are to this day remnants of Roman buildings in Germany but their style has had little or no effect on the development of German architecture. Theodoric the Great, king of the Ostrogoths (455 (or 454)–526), who resided throughout most of his reign in Ravenna, is the first who consciously endeavored to turn the minds of his people to the art of architecture, and his well-preserved tomb in Ravenna may be called the first extant Germanic building of art value. As was natural the plan of the building follows the plans of similar buildings in vogue in Italy at that time, a circular and vaulted central hall. Unique, however, and characteristic of the almost barbaric splendor of the great king, is the huge vault itself, chiseled from a gigantic monolith. The «handles» by which the block was raised in position have been left standing, and form a somewhat crude but impressive ornament. A peculiar decoration in the inside, the so-called "tongues" ornament, carries a definite reminder of Germanic workmanship: for it was well known to the Germanic peoples while it was never used in distinctly Italian buildings. Great as were the deserts of Theodoric in the interest of German art, they are insignificant compared with those of Charlemagne (742–814). He was the first of the great emperors whose aim it was to develop their own country rather than to cross the Alps and settle there. His artistic inspiration, of course, came from Italy, but not only from Rome, with its treasures of antiquity, but also from Ravenna with its many early Christian churches and the monuments on which Theodoric had breathed the spirit of Germany. One of the best-known instances of the architecture under Charles is the chapel of his palace in Aix-la-Chapelle, badly altered by later additions, but unmistakably influenced by churches like San Vitale in Ravenna and the so-called old cathedral of Brescia. Otto von Metz is mentioned in history as the architect of the chapel of Aix. If, however, he made any designs for the details, he found at home no men sufficiently trained to execute them; for columns, windows and other parts of the building were bodily brought across the Alps. The plan of the building is a vaulted octagonal central hall to which are added in the east a rectangular space for the altar, and opposite this another which served as the entrance hall. Above this latter was the seat for the emperor. The final decoration in the shape of marble incrustations and mosaics and iron-wrought balustrades was not added to the building before the time of Otto III (983–1002). The balustrades were native work and they surprise by their almost classic beauty and simplicity. The whole building was a revelation to the people, and it is not surprising that it was copied in many parts of Germany, although only the chapel in Ottmarsheim in Alsace has been preserved to this dav. On the whole, however, the Aix Chapel was not destined to become typical for German church architecture. It happened to represent the less popular of the two styles of early Christian churches, the Central Hall and the Basilica. The former found its finest development in the East, while the West, including the Germanic coumtries, preferred the basilica. With its lofty and spacious main nave and, for additional space, two or four side aisles, with its raised apse admitting the altar and in front of this the seats for the clergy, with its easy adaptation to an easterly orientation, popular with the Christians, it is not astonishing that the basilica type of church completely satisfied the needs of church builders. This type had been developed in Italy. Under the great Charles and his successors it was destined to become also the distinctly German type — with one notable alteration, the lengthening of the cross aisle (which was frequently interposed between the main nave and the apse). The effect of this was the introduction of the shape of the cross into the ground plan of the building. Another innovation, found as early as the Carolingian era, was the extension of the choir (the space in front of the altar), which lengthened the lines beyond the cross aisle, and thus materially helped to give to the ground plan the shape of the cross. The cross was the symbol of the Church, and symbolism was destined to play an important part in the whole of early German architecture. In the Italian prototype the choir and the apse had been but slightly raised. In the German churches they were raised considerably, and beneath them crypts were built. Frequently the German churches were dedicated to more than one saint or martyr, and in that case additional choirs became a necessity. Instances of such churches are found in Fulda, in Cologne (the old cathedral), and in Saint Gall. While the latter church has been destroyed, the original plans, not only for the church, but for the whole monastery, are extant. They were sent to the Abbot Gozbert by an unknown friend about 820, and thus permit the detailed study of German architecture at that time.

Charlemagne was the last important internationalist, ruling like the old emperors of Rome, not only over his own people but also over the whole western civilized world. His successors were unable to maintain their power; great changes took place in the world; and when the next great emperor, Otto I (936–973) ordered the emperor's crown to be placed on his head, he was a national ruler, holding sway, himself and his successors, in their native Germany and only occasionally also in conquered Italy. Germany as well as France had become distinct nationalities, each with a well-defined national consciousness. This is the first characteristic of the ensuing art. Another is the result of the submission of the individual to the doctrines of the Church. It was the age of the Crusades, of blood shed copiously and exultantly in the service of the Lord of Peace. It was the great age of contradictions, of splendid edifices housing men and women who had dedicated their lives to poverty; of humility toward God and their fellow-men; of contempt for worldly goods but devotion to the finest that art could give. Art in any age depends on man's relation to nature. The ancient Greeks and Romans had loved her, and this had shown in their art. In the Middle Ages religion attempted to draw man's thoughts away from nature. Saint Augustine exclaimed that God can be known only to the extent to which He is loved. The love of God and of the saints is at the bottom of German church-architecture of the Middle Ages, which can be understood and appreciated only from this point of view. At first the technical knowledge at the disposal of the architects was insufficient to accomplish their aims, but when the principles underlying Gothic architecture had freed artists from the demands made by the weight of the material in which they built, the structures they erected were the adequate expression of man's yearning for God and His Heaven. Living in nature, the mediæval architects had to borrow their forms from nature. But it was not the similarity of these forms to nature, but their ability to express ideas and emotions which counted. The so-called Romanesque architecture is a Germanic product, springing up during the Middle Ages independently in every country where Germans lived or where the admixture of Germanic blood was very strong, as in the northern part of France, in Normandy, Burgundy, Lombardy and England. The ground plan of the Romanesque churches was practically the same as that of the modified basilica as used in Germany. Secular and ecclesiastic princes vied with each other in the erection of costly and huge buildings. Cologne had her art-loving Archbishop Bruno, the brother of Emperor Otto I. Heinrich II did most for Regensburg and Bamberg; Conrad II for Limburg and Spires; Henry III for Goslar; while Henry IV ordered a new cathedral for Spires. Among the art-loving princes of the Church, Bernward von Hildesheim, Poppo von Stablo, Benno von Osnabrück, Adalbert von Bremen and Otto von Bamberg are the most famous.

Instances of the early Romanesque style during the 10th century are to be found in Reichenau, Quedlingburg, Gernrode and Paderborn. These buildings are heavy in appearance, being far more massive than structural necessity demands. Everywhere the artist is the slave of his material. During the 11th century greater freedom was obtained, at first in Lower Saxony and soon everywhere. The Michaelskirche in Hildesheim (dedicated in 1033) is a basilica with a flat ceiling. Other magnificent basilica-like structures are the cathedral of Hildesheim (1061), the abbey-church of Gandersheim, the emperor's cathedral in Goslar (dedicated in 1050 and destroyed in 1820), and the palace church in Quedlingburg (1070–1129). Often columns took the places of pilasters and great attention was paid to the elevation, as e.g., in the Saint Moritz Church of Hildesheim (latter half of the 11th century), the monastery church of Hersfeld (1038–1144), and the cathedrals of Minden, Bremen and Paderborn. In the Rhenish provinces the attempt was sometimes made to attain greater space by combining the ground plans of the basilica with that of the vaulted central hall, as for instance in Santa Maria of the Capitol in Cologne (1049). On the whole, however, the pure basilica type held its own also there, as in the splendid cathedrals of Mayence (1016), Spires (1030) and Worms (1036), all of which received vaulted ceilings in later days, and in the cathedrals of Würzburg and Constance, and the monastery church of Limburg on the Hardt. During the 12th century, when the architects had attained considerable freedom, and the religious fervor, which had been kindled by the Crusades, was reflected in art, the Romanesque style enjoyed a period of unwonted splendor. Vaulted ceilings are the rule, and in loftiness many of the churches erected at this time approach the magnificence of the Gothic style. It is the great building period, which makes it impossible to mention more than a mere fraction of the finest structures. Among the finest is the cathedral of Limburg on the Lahn (dedicated in 1235), with its seven most imposing steeples. The cathedrals of Soest, Osnabrück, Münster and Paderborn, all in Westphalia, while stately, do not approach the magnificence of the Rhenish churches. Among the Saxon churches those of Paulinzelle, Wecheselburg and Riddaghausen, and the cathedrals of Brunswick (1194) and Naumburg may be mentioned. In the district of Franconia, the cathedral of Bamberg is the most stately, while along the upper Rhine, where the influence of the technical ability displayed in Burgundy was strongest, the cathedrals of Basel, Zürich and Strassburg are well known. Elsewhere in Germany fine churches were built but few of them deserve mention by the side of those given above. Of the many secular buildings of this period the castles (Burgen) of the knights and the palaces of the princes (e.g., the emperor's house in Goslar) deserve mention. Long before the Romanesque style had run its course or had exhausted its possibilities, the Gothic style, invented in the neighborhood of Paris during the middle of the 12th century, swept everything before it, first by introducing modifications, and then by completely superseding the Romanesque style. The most notable outward characteristic of the Gothic style is the pointed arch. This is first found in solitary instances in the church of Saint Gereon in Cologne (1219–27), in the cathedral of Limburg, mentioned above, and in the monastery church of Heisterbach. Its first use as an integral part of the construction of a German church may be noted in the cathedral of Magdeburg (begun in 1207). The Leibfraunkirche in Treves and the Elisabethkirche in Marburg are the first distinctly Gothic German churches. On the upper Rhine the Gothic style made the quickest headway, and the cathedrals of Freiburg and of Strassburg (in part) are its finest monuments there. In Cologne the cathedral was begun in 1248 in imitation of the cathedral of Amiens. It was, however, left unfinished until the end of the 19th century. In Saxony and elsewhere in Germany the Romanesque and Gothic styles were as first mixed, with an ever stronger emphasis being placed on the Gothic (e.g., the cathedrals of Halberstadt, Meissen and Minden). In 1275 the cathedral of Regensburg was begun, which has been called the finest example of German Gothic architecture. Among the secular buildings of this period the homes of the orders of the knights deserve special mention, and among them again the Marienburg near Danzig.

The great political disturbances of the 14th century, the decline of the empire, the increase in power of the burghers, and the gradual transition of artistic initiative from the princes, both secular and ecclesiastic, to the wealthy patricians of the many flourishing cities, or to the cities themselves, wrought great changes in the architecture of Germany. The great increase in population of the larger cities demanded larger churches, and hugeness of space rather than artistic perfection was sought for. This led to changes in the ground plan, where the central hall was often preferred. The so-called Luxemburg emperors having displayed great activity in building in Bohemia, it was this section of the empire whence the new style spread. The cathedral of Prague (begun in 1334) became typical for many churches, especially in Bavaria and the whole of Austria. The Theyn-Church in Prague, while retaining the long main nave, omitted the cross nave, and this also became typical for many German churches, for instance, the cathedral of Schwerin and the Marienkirche of Rostock. The huge Stephanskirche in Vienna (begun in 1359) is akin to these churches, as is also the Lambertskirche of Münster. In all these churches the greatest attention was paid to the towers and steeples. While at first individual architects are rarely mentioned, their names came into prominence from the 14th century onward, and often whole families of architects enjoyed great reputation during succeeding generations. The Erwins were natives of Strassburg; and the Parlers of Prague. Ulrich von Ensingen, who died in 1419, built the tower on the west façade of the cathedral of Ulm, and carried the north tower of the cathedral of Strassburg up to the octagonal belfry which was finished in 1439 by Johann Hültz of Cologne. Other famous names are Matthäus von Ensingen, Wenzel von Krumau, Hans and Matthäus Böblinger, and Hans and Kaspar Kun. The late Gothic, so-called, characterized by great technical perfection and a tendency at solving, in the design of the arches and of the vaults, difficult mathematical problems, prevailed during the 15th century, not so much in building new churches, as in restoring or remodeling old ones. During the latter part of this century the effort is noticeable, especially in secular buildings, to have the Gothic forms create new ones, by more closely approaching nature in their ornamentation, and by supplanting the pointed arch with arbitrary creations of the artist's fancy. A well-known instance of such tendencies is the Albrechtsburg in Meissen. Gradually also the Renaissance style, which had become all powerful in Italy, gained in favor in Germany, where it made its first appearance early in the 16th century. When the great religious cleavage took place in Germany, and the Protestants built their own new churches, it was natural that they should prefer also a new style. Thus the great palace church in Torgau is built as a great hall in the Renaissance style. This same style was also preferred for princely residences as in Dresden and Heidelburg (the so-called Otto Heinrich part, built 1556–63) and for town-halls, as in Cologne, Bremen, Augsburg and Regensburg. As the best instance of the High Renaissance the castle of Aschaffenburg may be mentioned. Of German buildings erected at this time by Italian artists, the Belvidere in Prague is the best known. Toward the end of the 16th century what is called the «Baroque» with its fanciful and heavy lines and decorations began to gain favor also in Germany (e.g., the Friedrichs' part of the castle of Heidelberg), but before it could win general acceptance, the Thirty Years' War broke out, and by the misery which followed in its train put an abrupt end to all art endeavors in Germany. When the war was over, and conditions had become more settled toward the end of the 17th century, the religious division of Germany was reflected in the resumption of her artistic endeavors. In the north her art was under the influence of Protestant, Netherlandish artists, and later the Protestant Huguenots. In the south the Catholic Italians were preferred. This latter preference was most natural, because during the war and soon thereafter a great many Italian artists had been at work in Austria, where they had erected among other churches the magnificent cathedral of Salzburg. The Theatine Church in Munich was built by Zuccale, the cathedral of Passau by Antonio Carlone and the Hofkirche in Dresden by Chiavery. In the north, both native and foreign architects were at first primarily interested in finding new forms adapted to Protestant worship. Gradually, however, also here artistic endeavors came into their own, and among the earliest great architects of this new period Korb in Hanover and Starke in Dresden may be mentioned. The latter built the palace in the «Grossem Garten.» Greater, however, than either of these men was the architect of the royal castle in Berlin, Andreas Schlüter, a distinct personality in the history of art, with some leanings toward the baroque style. The best-known representatives of this exaggerated style, however, were to be found in Dresden, where M. D. Pöppelmann built the most perfect baroque building known as the «Zwinger,» and George Bähr designed the typical Protestant church in the shape of the Frauenkirche. While churches continued to be built during the 18th century, the greatest artists were called into the service of the reigning houses who filled their places of residence with castles and palaces in imitation of the great French king, Louis XIV, and his successors. In France at that time the Renaissance style had begun to give way before a formal classicism, and it was inevitable that German art had to follow much the same course. The love which Frederick the Great bore for everything French made Berlin the centre of classicism, although throughout Germany the way for the French imitation had been prepared by the previous generation of fine interior decorators who had introduced in Germany the light and fanciful French rococo. Some of the rococo artists later espoused the cause of classicism, as did von Knobelsdorf, the architect of the Royal Opera house in Berlin, who previously had decorated the castles of Potsdam and Charlottenburg, and achieved a reputation second only to that of Cuvilliés and Effner in Munich, or of Knöfel in Dresden. C. G. Langhaus (the architect of the Brandenburg Gate in Berlin), Unger, von Gontard, Gilly, Gentz (the architect of the Mint), K. F. Langhaus, in Berlin; Neumann the Younger, in the western part of Germany; von Fischer, in Munich; Weinbrenner, in Karlsruhe; Laves, in Hanover; von Erdmannsdorf, in central Europe; and Nobile and Spranger in Vienna were among the most famous classicist architects. All these men, however, were but forerunners to the really great German classicists, Leo von Klemze in Munich and Friederich Schinkel in Berlin. The latter especially was no mere formalist; for he was deeply impressed by the discoveries which had then begun to be made in Greece and the fine interpretation of which by the English scholars had opened the eyes of the most thoughtful to the singular beauty and simplicity of Greek architecture. Of his many works it may suffice to mention «The New Guard,» the Royal Theatre and the old Museum, all in Berlin, and the castles Glienicke, Charlottenhof and Babelsberg. His design for a magnificent castle for the empress of Russia in Orianda in the Crimea was unfortunately not executed. Schinkel's followers, therefore, were properly called «Hellenists,» or according to the great textbook of their school, Bötticher's 'Tektonik der Hellenen,' or 'Tectonists.' Stüler, Schadow, Strack, Hitzig, Gropius, Adler, Orth, Jakobstal and Eggert are among the best-known architects of this school. The remarkable thing about the greatest of these so-called classicists was their versatility. They refused to be bound by one style, and Schinkel, for instance, loved the old German art of the Middle Ages as dearly as that of the classicists. He was in fact, jointly with Friedrich Gärtner of Munich, the founder of the so-called Romanticist school whose representatives were offered ample scope by the restoration of old churches which took place all over Germany. Ahlert, Zwirner and Voigtel restored and rebuilt the cathedral in Cologne. Statz, Denziger, Beyer, von Schmidt, Mocker, and especially Otzen, Möckel and Hase achieved great successes. By the side of these men who drew their inspiration from the Middle Ages, another school developed, basing its efforts more largely on the Renaissance. The earliest of these men and the one whose books on the subject were most influential was Semper. Other artists following the same lines were Leins and Engle in Stuttgart; Nicolai in Dresden; Demmler in Schwerin; Förster, Hausen, von der Null and Siccardsburg in Vienna; and Neureuther in Munich. None of these men, however, was the slave of the Renaissance, and it is noteworthy that in designing churches they more than once employed Gothic forms. It was in short characteristic of practically all great architects of Germany during the 19th century that they looked upon the styles of the past which they most admired, not as copy plates to be imitated but as sources of inspiration. Consequently it is not astonishing that the distinction between the Romanticists and the Renaissance men soon disappeared. The great endeavor of many of these men was to initiate a modern style, i.e., a style adapted to the modern age, expressive of the spirit permeating their own age, and at the same time satisfying the artistic craving of those who had become familiar with the best architecture of all ages.

Since few men are experts both in designing the structure and in decorating its details, it frequently happens that two or more men combined in one architectural firm, and beginning with the middle of the 19th century such firms rather than individual architects appear as the builders of many of the best-known edifices. Among such firms may be mentioned: Ende and Böckmann, the architects of the Red Castle, the Industrial Building in Berlin, the Ethnographical Museum and many banks; von der Hude and Hennike, who built the Lessing Theatre in Berlin and several large hotels; Kyllmann and Heyden, who built several museums; Ebe and Benda, who built the «Pringsheim House» in the Wilhelmstrasse in Berlin in the style of the Italian High Renaissance, and by the use of glass mosaics and terracottas introduced a gaiety of colors which made this house the talk of Berlin, if not of the whole of Germany. Kayser and Grossheim were equally as fond of polychromy in architecture, while Gropius and Schmieden made use of it in telling moderation, especially in their well-known Arts and Crafts Museum in Berlin. Among the best architects of railway stations, Franz Schwechtern deserves mention, who built the Anhalter Bahnhof in Berlin, while August Soller, Eduard Knoblauch and Johannes Otzen are among the best-known church architects. Soller built the Catholic Saint Michaelskirche in adaptation of the brick churches of upper Italy; Knoblauch made use of Moorish elements which he cleverly combined with structural iron in his «New Synagogue»; and Otzen gave preference to the Romanesque and the Gothic in his Protestant churches. Beginning with the '80s of the 19th century, Berlin was one of the fastest growing cities of the world, which accounts for the fact that more architects of importance found occupation there than anywhere else in Germany, in spite of the great opportunities offered by the art-loving King Ludwig II of Bavaria. Next to Berlin, however, Munich continued to be a centre of good architecture. Of the long list of good architects there, Lorenz Gedon deserves special mention as the builder of the Schack Gallery, erected soon after the creation of the new German Empire, in the style of the German Renaissance. Of the other cities of Germany, Frankfort holds a unique position with its many fine buildings, the new Museum, the Grand Central station, the Exchange, all built by native talent for only the Opera house was entrusted to an outsider, Richard Lucä of Berlin. Of the most important outside commissions entrusted to Frankfort architects, the Grand Central station in Vienna and the town hall in Hamburg were given to Karl Mylius and Alfred Bluntschli, while the Reichstag building in Berlin was given to Paul Wallot. Wallot endeavored to find a modern national style, but as he himself once said, you cannot find such a style from to-day to to-morrow, and although he has cleverly combined many elements of German Gothic and German Renaissance and has added not a little of his own, the result is not altogether pleasing. The demands of the interior, adapting it to the convenience of the members of Parliament and to their needs, were greater than could be met in the given space without forcing compromises in design such as had to tell unfavorably on the exterior. Everybody familiar with our own, externally magnificent Capitol in Washington and its waste of space internally, will appreciate the difficulty of the task set to Wallot, and will appreciate his relative success rather than criticize his shortcomings. All the buildings mentioned thus far may be grouped together as following the historical style of architecture. In the hands of masters this style was able to produce fine structures. Unfortunately, however, the amount of building done in Germany from 1871 on, when the new empire was founded and the huge increase in population began, was so enormous that in most instances artisans rather than artists had to take charge of designing and erecting the buildings. In the hands of many of these master builders the historical style deteriorated to a mere fashion, and since it was used irrespectively of the requirements of given cases, Germany is unfortunately filled, especially in the smaller towns and cities, with buildings of which a future generation will hardly be proud. It was natural therefore that a reaction should set in. The exact date of its beginning it would be difficult to tell. Early in the 20th century, however, it was an accomplished fact. The aims of the modern German architects have been thus formulated by as keen an observer as Prof. Walther Gensel: «Clearly to express the purpose of the building; to work from the inside out; not to do violence to the material selected by forcing it into forms contrary to its nature; to pay chief attention to proportions; and to consider the requirements of the building either as a part of the street where it is to be erected, or as a spot in the landscape» are the aims of modern German architecture. Working along these lines it is not astonishing that the present generation of German architects should have achieved singular successes. The greatest teacher of these principles is perhaps Karl Schäfer in Karlsruhe; the number of men following them, however, is too great to mention more than a very few. Gabriel Seidl built the new National Museum in Munich; Hugo Licht, the Public Market in Leipzig, and Alfred Messel, the great Wertheim Stores in Berlin. A survey of modern German architecture would be incomplete without a reference to the many private residences, in town as well as in the country, which have latterly been built. The earlier delight in display has disappeared. The individual building does no longer endeavor to force the attention of the passer-by. On the contrary, it is satisfied with being a part of an artistic whole, or, in the country, with harmonizing with its surroundings. Wherever possible, stately soberness has given way to simple gaiety, in keeping with the turn of mind of the German people early in the 20th century, which took great pleasure in life. Nowhere, however, is this gaiety permitted to obtrude itself where it would be out of place, as for instance in large industrial plants, railway stations or elevated railroads. These are treated without any attempt at disguising their purpose. Excellent instances of this are found in the railway stations and elevated railroads in Berlin.

Bibliography.— Reber, 'History of Mediæval Architecture'; Lübke, 'Ecclesiastical Art in Germany During the Middle Ages'; Lübke, 'Geschichte der Renaissance in Deutschland'; Licht, 'Architektur Deutschlands'; Knackfuss, H., Zimmermann, Max, Gg., and Gensel, W., 'Allgemeine Kunstgeschichte' (Leipzig 1903).

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16. HISTORY OF GERMAN MUSIC. The chief epochs in the history of German music are these,— sacred, polyphonic music, and its culmination in the works of Bach and Handel; the birth and development of modern instrumental forms; the German romantic opera,— von Weber; the German Lied; the Romantic school, Schumann, Liszt; the music dramas of Wagner; modern tendencies as found in the works of Strauss and others.

The first promising epoch in the development of German music was the Reformation. In that period of storm and stress, of burning questions and of intense longing for religious and social independence, sacred music, that expression of man's belief in the Eternal, was cultivated with the greatest fervor. The music which was the natural outcome of such conditions was of far-reaching influence, especially upon the great vocal and instrumental compositions of Sebastian Bach (q.v.).

Martin Luther, the leader of the movement, was not a composer of chorals or hymn-tunes, as is often supposed, but a writer of the words of hymns to which he and others set traditional melodies taken from the rich stores of religious folk-songs then extant. Luther's distinct contribution to the musical life of the time was (1) his writing of about 30 hymns which, deeply imbued with patriotic and moral feeling, spoke directly to the heart of the German people, and (2) his associating with him the best musicians of the period to collect and write chorals suited to his words. Of these the most famous were Johann Walther and Ludwig Senfl.

In 1524 there was published in Wittenberg Walther's choral-book with a preface by Luther. The melody of 'Ein Feste Burg,' which Frederick the Great called "God Almighty's grenadier march," has exercised a powerful influence throughout the course of German music, as may be seen from the prominent part it bears in the works of Bach, Mendelssohn (Reformation Symphony), Meyerbeer (Huguenots) and finally in Wagner who uses its strains in the 'Kaiser-March' to typify the military triumphs of united Germany.

The first representative composer, often spoken of as "the father of German music,"— whose works clearly foreshadowed two of the important directions of modern art,— was Heinrich Schütz (q.v.). He was born in 1585, just a century before Bach, and died in 1672, while he was court director of music at Dresden. Quite early in life he came under the stimulating influence of the Venetian school as a pupil of the famous Giovanni Gabrieli. Schütz, as the composer of the first German opera 'Daphne,' is the progenitor of the line which includes Glück, Mozart, von Weber and Wagner. Schütz's real importance however centres in his sacred compositions, the 'Resurrection,' the 'Seven Last Words' and the four settings of the Passion. In these works, in which a sacred story in dramatic form is told without the aid of scenery or action, Schütz was the real founder of German oratorio, and in his power of vivid, dramatic characterization anticipated some of the essential features in the Passions and oratorios of Bach and Handel. In Schütz we also see traces of that Teutonic power of introspection and deep thought which prevented German oratorio from yielding to the baleful theatrical influence of Italian music, and which, exercised by the great composers of the following century, led to such triumphant achievements in German art. The prime of Schütz's life unfortunately coincided with the Thirty Years' War (1618-48)— that time of devastation and horror which diverted all men from the peaceful cultivation of either art or literature.

On the other hand this period of ferment and of the breaking up of established routine had a stimulating effect upon German music in that composers were brought into closer touch with men and ideas from other nations. German artistic development had suffered from too much isolation, but henceforth, by reason of this intermingling of Continental peoples, music began to speak a more universal language. This change is strikingly typified in the instrumental suite which was a somewhat loosely connected series of national dances — as may be seen from the names of the principal numbers, allemande (Germany), courante or corrente (France or Italy), sarabande (Spain), bourée and gavotte (both French), and jig (English).

Prior to the complete development of the sonata and rondo forms in the time of Haydn, the suite was about the only instrumental form (with the exception of the fugue), which made any pretense to artistic organization, and was the favorite form in the clavichord compositions of Bach, Handel and contemporary composers.

The real supremacy of German music dates from the 18th century, for at that time began the careers of Bach and Handel (qq.v.), both born in the year 1685.

Handel was undoubtedly a man of great force of character and of quick comprehensive intellect; in whatever he undertook, as composer, impresario or chapel-master, he succeeded through sheer force of will and personal magnetism. His purely musical gifts, great as they were, often seem the least of his powers. His varied career affords a striking contrast to the simple life of Sebastian Bach, who spent his days in a rather obscure part of Germany, was practically unknown and certainly unappreciated outside his native land, and began to receive due recognition only about a century after his death.

Handel's early studies were made in Italy and in his 47 operas he stood forth as the finest representative up to that time of the flowing Italian vocal style. These operas, although now entirely obsolete on account of their weak, meaningless libretti and lack of dramatic unity, yet contain some of Handel's finest songs, and as a song-writer his power is undoubted.

Handel's fame to-day rests almost entirely upon his oratorios, among which may be mentioned 'Israel in Egypt,' 'Sampson,' 'Judas Maccabæus' and the 'Messiah.' His vast number of other instrumental and vocal works on account of their old-fashioned, conventional idiom, and their somewhat monotonous harmonic scheme, are fast becoming obsolete. In the oratorios, although they contain many arias noted for pathos and beauty of expression, the choruses are the portions in which Handel's distinctive power is chiefly shown. His vocal solos are too often of stereotyped design and defaced by meaningless roulades — a survival of the vainglorious operatic style of the period. As a chorus-writer, Handel is supreme in the history of music. He was a great impressionist and for dramatic effect, for majesty and dignity of utterance in dealing with large masses of voices, has never been surpassed. Early in middle life Handel became a naturalized Englishman, wrote his most famous works to English words, with special reference to English religious feeling, and so his influence there has at times amounted almost to idolatry. Upon other nations, France, Italy and Germany, Handel's influence has been much less and is weakening year by year.

If human greatness is to be measured by a constantly growing consensus of approval, Bach was in some ways the greatest musician who ever lived. He is practically the founder of modern music, and his influence is supreme in such different composers as Beethoven, Schumann, Chopin and Wagner (qq.v.). In wealth of harmonic resource Bach was at least a century ahead of his time, and only recently have the inexhaustible vitality and suggestiveness of his works been fully appreciated. Bach's power is shown in three important branches of composition — as a choral-writer, as an organ-composer and as the precursor of the important modern developments in pianoforte style and pianoforte playing. Bach's great choral-works are the two settings of the 'Passion according to Saint Matthew' and 'Saint John,' the 'B minor Mass,' the 'Christmas Oratorio,' and innumerable church cantatas. Words are entirely inadequate to describe the sublimity and pathos of these stupendous cathedrals in tone. In the words of Schumann "music owes almost as great a debt to Bach as religion owes to its Founder."

To the general public Bach is best known by his organ-compositions, Preludes, Fugues, Toccatas, Fantasies, Choral-Preludes, etc., and as an organ composer no one can even be mentioned in the same class. These works are all remarkable for their variety of construction, for their free, untrammeled use of every possible contrapuntal device, and notwithstanding their intricacy, for the complete subordination of mere learning to the needs of a personal expression of mood. Bach's most important work for clavier — the prototype of our modern pianoforte — is the 'Well-tempered Clavichord.' This work, in substance a set of 48 preludes and fugues (in all the major and minor keys)., took its name from the new system of tuning, largely originated and sanctioned by Bach, by which all keys became of equal importance, and modulation was made possible into remote tonalities. The 'Well-tempered Clavichord,' often called the musician's Bible, represents not only the essence of Bach's genius, but contains within it the seeds of the whole growth of music since that day. In strong distinction to the somewhat local influence of Handel, the leading composers of every nation, Italy, France, Germany, America, etc., have taken Bach as their model and have stated unmistakably that they have based their work on his. Other notable compositions of Bach are the French and English Suites, the Chromatic Fantasie and Fugue and the Two and Three-Voiced Inventions. Mention should be made of the Orchestral Suite in D, of the Sonatas for Violin and 'Cello, and of the celebrated Chaconne for violin solo.

Between the culmination of the vocal style of Bach and Handel and the development of modern instrumental music there was an interregnum, a period of overlapping tendencies, and of experimentation as to what the course of music should be.

Sebastian Bach himself said in the latter part of his life that musical taste had altered wonderfully and that the old music no longer sounded good to the ear.

Among many worthy names, two are of real prominence. Glück (q.v.) (1714–87), will always be honored as the first reformer of the opera, and although his best works, 'Iphigenia in Aulis' and 'Iphigenia in Tauris,' were written to French libretti and brought out in Paris, the peculiarly Teutonic characteristics of the man, his sincerity, his courage and unerring instinct for dramatic truth were the animating causes of his reforms. To carry them out Glück needed all the strong physical and mental qualities which came to him from his peasant ancestry. Italian opera as he found it was an artificial and undignified form of art, in complete subservience to the capricious whims of singers and the vitiated taste of ignorant patrons. Glück's title to fame is the fact that in such circumstances he set himself resolutely to express himself in his music, and to make it manly and sincere. His dramatic creed is expressed in the famous preface to 'Alceste.' One of his chief canons was to make the music subordinate to the spirit of the words,— a principle sometimes carried so far as to make the music lacking in beauty for its own sake.

Glück is rightly regarded as the father of modern opera; his theories and reforms have had great influence upon all opera composers, notably upon Wagner, and his works are the earliest which hold the stage to this day. He was great both in impassioned and pathetic melody and his dramatic use of the chorus is unsurpassed. He was also the first to anticipate in many ways the organization of our modern orchestra.

Emmanuel Bach (q.v.) (1714–88), third son of the great Sebastian, the forerunner of Haydn and Mozart, is important for his contribution to the development of instrumental form, especially in music for the clavier. In fact many of his first movements all but reach the completely organized sonata form as found in Haydn. He was also an important factor in settling the most effective manner of writing for the clavier, i.e., solo-melodies lightly accompanied, brilliant passage-work, etc., instead of the old polyphonic style on a vocal basis. His celebrated treatise on 'The true art of playing the Clavier' contains the principles which have since been developed by Clementi, Cramer and others into the pianoforte style of our own time.

Haydn (q.v.) (1732–1809) is called the father of the symphony and the string quartet, and the term, though a slight exaggeration, is well deserved, for he summed up and amplified the tentative efforts of the many instrumental composers of the period. Born at Rohrau in Austria, near the Hungarian frontier, his peasant origin and his life-long contact with the common people and with rural life must be kept in mind in estimating his music. Much light has been shed upon the causes of Haydn's peculiar genius by the researches of a Croatian scholar, Dr. Kuhac, who has shown conclusively that Haydn was of Croatian stock. The evident and pervasive signs in Haydn's music of light gipsy dance rhythms and of folk-songs are thus accounted for. His earlier years were of intense hardship and his musical education due almost entirely to his own efforts. Finally he came in 1761 under the patronage of the Esterhazy family in Hungary — a post held uninterruptedly for 30 years, in which Haydn's status was typical of the musical patronage in vogue at that epoch. The most prominent external events of Haydn's life were the two visits to London in 1791 and 1794 at the invitation of the violinist Salomon. For these occasions were composed the 12 «Salomon Symphonies» which include Haydn's best work — the 'Surprise,' the 'Oxford,' etc. Haydn received the degree of doctor of music at Oxford and also became acquainted with the vocal style of Handel, which influenced him in the composition of the 'Creation' and the 'Seasons,' those remarkable works of his old age. Haydn, a distinctly uneducated man, but one of great musical concentration, was just suited to organize the tunes and rhythms of the people into coherent forms of art. In movements in the so-called sonata form his establishment of the second theme and free treatment of thematic development were organic changes of the greatest moment. To the old three-movement sonata or symphony with its mechanical contrast of fast, slow, fast, Haydn added the minuet, in which his fondness for light graceful rhythms and spirit of playful humor found free scope. The modern string quartet owes almost more to Haydn than the symphony. His string quartets contain his most vital and lasting work and show his inexhaustibly fertile invention in varied rhythms and in the individualizing of the instruments. Haydn's music is noted for its cheerfulness and dainty grace, and though it seldom rises to a high level of dignity, bids fair to be immortal as a genuine expression of the optimistic sunny temperament of the man.

Mozart (q.v.) (1756–91), a most prolific genius, worked in every form of musical art known to his time; his significance, however, (from the standpoint of historical development) lies in his symphonies, his string quartets and allied forms, and most of all in his operas. Born at Salzburg, the son of Leopold Mozart, a famous violin teacher, the first 25 years of his life were chiefly spent in professional tours. His marvelous precocity both as composer and executant is well known. In 1772 he became music director at Salzburg, but unable to endure the galling system of patronage went in 1781 to Vienna, where he continued to pour forth masterpieces until his tragic death, largely brought on by poverty and hardship. He was buried in a pauper's grave. Mozart is the supreme example in history of the inborn spontaneous musical temperament, and his wonderful gifts were supplemented by a perfect mastery of the technique of his day. In some ways his music is more Italian than Teutonic, and though often limited in depth of expression, is perfect in its beauty of melodic outline, in its fineness of detail and in its serene purity of sound. His works are a complete embodiment of abstract classic beauty in distinction to the arbitrary self-expression of the Romantic composers.

Mozart's first string quartets (1782) were dedicated to Haydn, who greatly improved his own symphonic style by a study of Mozart's three great symphonies, all written in 1788. His pianoforte sonatas, owing to the limitations of the instruments of that time, are often superficial, but in his compositions for pianoforte and orchestra he is virtually the founder of the modern pianoforte concerto.

Mozart's most vital influence is felt in his operas. In no way a reformer like Gluck, he accepted the existing Italian models, but through sheer power of musical beauty and wonderful dramatic characterization he creates the greatest operatic works of his century, which to-day are still full of life. The most important are 'Don Giovanni,' 'Figaro' and 'Così fan Tutte.' The operas written to German words, including 'Die Entfhrung aus dem Serail' and 'Die Zauberflöte' are of historic interest from their connection with the German Singspiel and as forerunners of the romantic opera of the following century.

Beethoven's (q.v.) (1770–1827) historic relationship is akin to that of Bach in that he concentrated all forms of expression then extant, and also foreshadowed many of the important developments still to come. His artistic growth is to be studied in relation to his times. His life coincided with the French Revolution, with the American War of Independence and the German struggle for national unity; the most prominent single note in his music, the free expression of individualism, is a definite result of the spirit of emancipation so prevalent in both literature and political life, and shows Beethoven's intense susceptibility to all the contemporary currents of thought. With him music ceases to be merely an art depending for its effect upon fineness of workmanship; it becomes a language capable of expressing the deepest emotions of the composer and voicing the joys and sorrows of humanity. Beethoven, of mixed ancestry, was born at Bonn but spent the chief part of his life in Vienna and its neighborhood. His sturdy characteristics of body and mind may be traced to his Dutch grandfather while his intensely emotional and romantic nature came from the German blood on the maternal side.

Beethoven's greatness depends on the perfect equipoise found in his works of the intellectual and emotional elements. His symphonies and sonatas embody the most carefully planned musical architecture and yet are so surcharged with emotion that our deepest feelings are touched. In him the principle of thematic development reached its climax; entire movements were founded on some striking motive, e.g., the opening movements of the 'Heroic' and the Fifth symphonies. This method of construction, by which instrumental music was freed from its former diffuseness, has had great influence on all modern composers.

Beethoven's sketch books illustrate his method of work; we see how an idea springing from an emotional source was worked over, changed and improved, until it could stand forth as a perfect expression of musical thought. This concentration is shown by the fact that, although an unceasing worker for 37 years, he produced but 133 works, in contrast to the many hundreds of Haydn and Mozart which are largely in the same style.

Beethoven in variety of conception ranks with Shakespeare. Each of his nine symphonies is unique, differing from any one of the others. He also first revealed the possibilities of humor in music as distinct from the light wit and playfulness of Haydn, and in many of his works substituted for the minuet a movement to which he gave the name «Scherzo.» His nature had a vein of brusquerie and irony and this may be seen manifested in such movements as the scherzi of the Third and Fifth symphonies and in the finale of the Eighth.

Great advance in the art of orchestration is due to Beethoven; he studied the expressive qualities of each instrument and first showed the entire capabilities of the horns, clarinets, kettledrums, contrabass, and bassoons. His imagination was distinctly orchestral, even when he was composing for the pianoforte. In Beethoven's works we see striking anticipations of modern «programmistic» tendencies, witness the frequent titles, e.g., the 'Heroic' and 'Pastoral' symphonies, the overtures to 'Coriolanus' and 'Egmont'; the sonata called 'Adieu, Absence and Return.' He said himself that he generally composed with some poetic thought in mind, and his music is often symbolic of mental states. His favorite name was «Ton Dichter.» Since his day there has been a growing tendency to bring instrumental music into closer touch with external poetic thoughts. Beethoven, though not highly educated in the modern sense, was of a powerful, comprehensive intellect. His disposition, a strange mixture of contradictory traits, was at bottom warm-hearted and loyal. His character was one of perfect honor. Although thrown back on himself by his deafness which began in his 30th year his music never became morbid, but continued to sound the notes of sublimity and spiritual exaltation. He would not allow «destiny to drag him down,» kept a firm grasp on his lofty ideals, the love of liberty, the brotherhood of man, and expressed them in immortal music in his 'Heroic' symphony and in the 'Choral' symphony, the last movement of which is based on Schiller's 'Ode to Joy.' Beethoven is the central figure in the development of music. His supreme power is manifested in his influence over all the composers of the 19th century as indicated in their works and recorded eulogies.

During the latter part of Beethoven's life, i.e., the first quarter of the 19th century, there were going on two most important movements in German music, the creation of a distinctly German opera, and the establishment of the German Lied. The former is chiefly due to the genius of von Weber (q.v.) (1786–1826), the latter to that of Franz Schubert (q.v.) (1797–1828). Both these achievements had their birth in the war of liberation waged in art and literature against the long domination of French and Italian standards. Weber did not create the German romantic opera *de novo*. Its origin was in the Singspiel, a light piece with plot and characters drawn from native sources, copiously supplied with incidental music often based on folk-songs. Fairy tales and local legends were also much used. Closely connected with this operatic movement was the Romantic school of poetry founded about 1800. Breaking away from classic themes the Romanticists found their inspiration in the German world about them, the mystery of the forest, the charm of out-of-door peasant life, etc., and upon such themes and other fantastic subjects suggested by his glowing imagination Weber built his dramatic works. His first success was gained during the Napoleonic invasion by some spirited settings of Körner's war songs 'Lyer und Schwert.' His great operatic triumphs began with 'Der Freischutz' in 1821, that most German of operas, the mere name of which affords a clue to the wealth of color and fancy displayed in the descriptive music.

Weber's wonderful power of characterization was unique at the time, and has by no means lost its telling force to-day. He was completely saturated with the romantic spirit and entered in his works all the realms of fancy thrown open by the poets. Thus in 'Euryanthe' we are taken back to the Middle Ages, and the days of chivalry in 'Oberon,' brought out in London in 1826, we hear «the horns of Elfland faintly blowing.» Weber was also of considerable influence in his pianoforte compositions, as a forerunner of the «brilliant» school of Liszt (q.v.), and others.

Spohr (q.v.) deserves passing notice as an associate with Weber in the romantic movement in opera, and as one of the great violinists of his day. Although essentially a classicist, Spohr often gave titles to his instrumental works. They are lacking, however, in real poetic vitality, and so are seldom heard to-day.

Schubert (q.v.), the inheritor of Mozart and Beethoven, the last of the purely classic school, notwithstanding the many interesting phases of his genius, must be treated here as the founder of the German Lied (see LIED), the first of the great group of song composers which includes Schumann, Franz, Brahms, and Richard Strauss. Schubert, whose highest gift was that of expressive melody, with an imagination keenly susceptible to poetic suggestion, lived at just the right epoch to take full advantage of the wealth of German lyric poetry which was one of the results of the romantic movement. The difference between the Lied and other earlier forms of solo song, aria, etc., is that no longer the music itself is the chief element, but the word-text. Instead of setting several stanzas to the same simple tune the composer endeavors by continuous musical development to suggest every sentiment and mood of the poem. Imagination is made submissive to the suggestiveness of the poet. The music exists not independently, but as a means of carrying the essence of the poem to the soul of the hearer. Words and music are blended in a composite form of art, which is always enhanced by suggestive pianoforte accompaniment. In the union of these three factors Schubert was supreme. With few exceptions he always selected poems of intrinsic merit, e.g., by Goethe, Schiller, Shakespeare, Klopstock, Müller, and Heine; of unsurpassed power as a melodist, he followed each varying sentiment of the words in the most subtle manner, and although recent composers have enlarged the scope of the piano accompaniment, he first revealed its possibilities. In illustration of the last point we may cite the accompaniment to 'Der Erlkönig' and 'Aufdem Wasser zu singen.' Schubert's genius for instrumental music was continually growing; indeed it was his intention to devote himself to orchestral music. His early tragic death cut short these fair prospects, but we have a priceless legacy in the great symphonies — the 'Unfinished' and the one in C major — and in the Chamber music — notably the Quartet in D minor. These are inferior to the best works of Beethoven only in a certain lack of organic concentrated treatment; in warmth of melody, in wealth of tonal effect and in boldness of modulation they have seldom been surpassed. Schubert's short characteristic pieces for pianoforte, such as the 'Impromptus,' 'Moments Musicaux,' waltzes, etc., are unique in style and of great interest in that they opened the way for the short lyric forms in modern literature. Witness the pianoforte compositions of Schumann, Mendelssohn, Grieg, and Brahms.

In 1830, two years after the death of Schubert, began the career of Schumann (born in 1810), the most prominent — together with his great contemporary, Berlioz (q.v.) — of the romantic composers in the realm of instrumental music. In Schumann we have a unique personality, intensely subjective and of deep poetic feeling — "the greatest musical thinker since Beethoven" according to Liszt. Manifesting very early a strong love for the imaginative poets of the period, notably Jean Paul Richter (q.v.), Schumann definitely molded his music in accord with poetic ideas, and with his great literary gifts became the formulator of the romantic idea in the entire musical thought of the time. Up to 1840 Schumann's chief work was his pianoforte compositions. These although in small form, from the novelty of their style, and their exquisite fancy, began a new epoch in pianoforte music. These pieces all have titles, 'Papillons,' 'Nachtstücke,' 'Fantasiestücke,' etc., and indicate with delicate touches of romanticism the moods which the music is to symbolize. In his larger pianoforte works the two sonatas, the Fantasie in C and the Etudes Symphoniques, the defects as well as the merits of the school are apparent. Together with a wealth of invention there is often a lack of balance and unity. The romanticist always teems with emotion; whether he succeeds in impressing this on the hearer by means of music is quite another question.

In 1840, the year of Schumann's marriage with Clara Wieck, most of his wonderful songs were composed. In some ways these surpass even Schubert, especially in delicate treatment of subtle shades of meaning in the poems and in variety of piano accompaniment. Many of his most inspired songs are set to poems by Heine. In his four symphonies, Schumann was of unequal power, and opinions vary as to their permanent worth. There is no doubt of the warmth and variety of the original ideas, but sustained development is often lacking and the orchestration leaves much to be desired. By far the strongest of the symphonies is the Second in C major in which the Adagio with its poignant pathos reaches a high point of emotional expression. The Fourth symphony is noteworthy for experiments in a more plastic treatment of the conventional symphonic form. Schumann's vocal works, though unequal, contain much fine inspiration — the most sustained is 'Manfred.' Schumann's literary labors in founding 'Die neue Zeitschrift für musik' in 1834 must not be overlooked. His critical writings with those of Berlioz and Liszt have revolutionized musical taste and established new ideals.

Mendelssohn (q.v.) (1809–47), Schumann's contemporary, although classed with the German school from the style of his works, is, strictly speaking, outside the Teutonic line, as he was of Jewish extraction on both sides.

Franz Liszt (q.v.) (1811–86), although likewise not of pure Teutonic blood — his father was a Hungarian — is of far greater importance, not only for his intrinsic powers as composer and pianist, but for the stimulating influence he has had upon the musical culture of the day. Any sketch of Liszt must be inadequate, and is to be supplemented by reference to the vast amount of biographic and critical literature connected with him and his tendencies. He is one of the compelling forces in music of our times. The greatest pianist the world has ever seen, the modern school of pianoforte playing is largely derived from him. In his pianoforte compositions many new elements were introduced in rhythm, harmony, freedom of form and pure pianistic effect. In many of these pieces a strong Hungarian, gipsy element is found. In his orchestral works Liszt is a firm adherent of the program school, agreeing with Berlioz as to the descriptive value of music. His two great symphonies, the 'Faust' and the 'Dante,' are unique works in their subtle musical characterization and in their beauty of orchestral tone-painting. In the 'Symphonic Poem' an entirely new form was contributed, one which has had far-reaching consequences not yet exhausted. A symphonic poem is a work in a single movement in which the classic sonata form is abjured and the entire structure and style of treatment are made subservient to the guiding spirit of the poetic subject. Of these works the most famous are 'Orpheus,' 'Tasso,' 'Mazeppa' and 'Les Preludes.' Liszt was also a prolific vocal composer and his masses and oratorios of 'Saint Elizabeth' and 'Christus' contain many noble thoughts. His solo songs are of rare distinction. Liszt's rank as a composer is still hotly debated and cannot yet be settled. His influence was certainly many-sided, as composer, critic, conductor, and teacher. From the loftiness of his ideals and the generosity of his character he has done an inestimable service in raising the standard of music in the eyes of the world. His championship of the dramatic reforms of Wagner is an inspiring chapter in the annals of art.

The comparative youth of modern music and likewise its continuity of development is strikingly shown by the fact that the birth of Wagner in 1813 is within four years of the death of Haydn in 1809. The mere name of Wagner (1813–83) provokes a wide range of discussion, but though to the specialist he may be of interest as a philosopher, a writer on æsthetics and a sociologist, by the general public he is admired as the founder of the music-drama, and as a mighty musician. Considerable harm, in fact, has been done to Wagner's music by the metaphysical speculation in which his rabid admirers have tried to submerge it. «I require nothing from the public,» writes Wagner to Liszt, «but healthy senses and a human heart.» Surely he may be taken at his own word in an estimate of his works. Wagner's reforms may be briefly summarized as follows: (1) To make the opera a serious and uplifting form of art instead of a mere passing amusement; (2) to treat in his dramas subjects which had moral and intellectual value; and (3) to combine all the factors, poetry, music, action and scenery into a homogeneous means of direct influence upon the emotion and intellect of the hearer. Wonderful as was Wagner's growth in originality, his early works show distinctly derivative influence. Brought up in the shadow of the theatre, his inborn dramatic instinct was strengthened by an early acquaintance with the works of Shakespeare, Goethe and Schiller, while on the musical side he became familiar with the operas of von Weber and the instrumental works of Beethoven, many of which he had copied out in score before his 18th year. The real Wagner begins with 'Der Fliegende Holländer.' In this, notwithstanding traces of French and Italian influence, the effort toward dramatic and musical unity is apparent. 'Tannhäuser' and 'Lohengrin' are transitional works in which we find certain survivals of conventional opera, together with prophecies of the highly developed, later style.

In his mature works, 'Der Ring,' 'Tristan,' 'Die Meistersinger' and 'Parsifal,' traditional forms, the aria, the set chorus, etc., are entirely renounced, and the growth and form of the music are derived from the spirit of the text. Richly accompanied recitative makes up the body of the work. The melody is composed poetically and, to use Wagner's term, is «endless,» running sometimes through a whole act without a break. The expansion of the descriptive powers of the orchestra reached a climax in Wagner. His power as a musical scene-painter is incontestible. Building on the work of von Weber, Berlioz, Meyerbeer and Liszt, he evolved an entirely new orchestra boundless in wealth of tone-color and in power of emotional appeal. In fact, the chief beauty is often in the instrumental part and the vocal melody is at times rather crudely plastered upon this. As a discoverer of new harmonic effects and as a contrapuntist, Wagner ranks with Bach and Beethoven.

One of Wagner's organic changes was the use of «Leading Motives.» These are not mere musical labels with fantastic names,— this conception is due to the misguided Wagner commentators,— but musical epitomes of the chief characters and the important objects in the drama, e.g., 'Wotan,' the 'Sword,' 'Fire,' etc. By their use the music though plastic becomes highly organic. Wagner himself says it is the thematic development of Beethoven expanded and used for dramatic purposes.

Not the least feature in Wagner's operas are the scenic effects. He revolutionized the art of stage mounting. Such scenes as the Grail Castle in 'Parsifal' and the final scene of 'Die Walküre' have never been surpassed. Wagner's pen as a literary man was ever busy. His writings are collected in 10 large volumes. The essays 'On the Art of Conducting' and on the symphonies of Beethoven are noteworthy.

The position of Brahms (q.v.) (1833–97) in modern music is remarkable in that by temperament standing apart from two of the main tendencies of the times, the operatic and the programistic, he made free use of the polyphony of Bach and the classic forms of Beethoven to voice his own individual message. A man of singularly deep and simple human feeling,— what strikes us most in his music is its emotional wholesomeness. Never morbid, hysterical or theatric, Brahms' compositions in their broad impersonality make the impression of a work of nature. With the exceptions just noted, Brahms has worked in every field of modern art. His pianoforte music, with its complexity of rhythm and its subtle harmonic tissue, is distinctive and novel. His songs in their consummate blending of poetic sentiment and musical expression are the most perfect since Schumann. The chamber-works for strings alone or for various combinations of instruments contain some of the noblest thoughts ever uttered in that form. Brahms' four symphonies are comparable with those of Beethoven in their variety and latent strength. Each has its own peculiar atmosphere; Brahms has not written *one* symphony in *four* parts. His 'German Requiem' is one of the grandest compositions of modern times.

Debate is still going on as to the final position of Brahms. To some he seems austere, lacking in emotional warmth; to others he represents all that is truest in music. He is certainly one of the few since Beethoven to sound the note of sublimity. His music is Miltonic in its dignity and repose. Such qualities may well be considered lasting in music.

Since Wagner and Brahms the German school has been most prolific but there are only a few men in modern German music who count at all. Most important is Richard Strauss (q.v.) (1864), who has carried the program method to undreamed-of lengths. In technical resource Strauss is undoubtedly the greatest master of the orchestra who has yet appeared. In his great symphonic poems 'Don Juan,' 'Tod und Verklärung,' 'Also sprach Zarathustra,' and others, by utilizing and expounding the discoveries of Berlioz, Liszt, and Wagner, he has produced orchestral effects of brilliance and sonority which are unparalleled. Strauss is also a composer of prodigious contrapuntal skill, and his works are marvels of musical architecture. In fact so audacious is the use he makes of his descriptive and realistic powers that music seems to be changing its entire nature. The controversy rages about him and his tendencies as violently as in former times about Wagner. It would be premature to forecast Strauss' permanent rank. Whatever else he has done he has weakened the former assertion that music has no power of definite portrayal. So wonderful are his efforts of musical symbolism that music just stops short of being articulate. Such vast works as 'Ein Heldenleben' and 'Don Quixote' have emanated from the most daring musical imagination of our time, and embody tendencies which cannot be ignored. Music no longer exists primarily for its own sake, but as a means of descriptive expression for whatever philosophic or psychologic scheme the composer may have in mind. Strauss has also written in the smaller forms with distinct success piano pieces, chamber music, etc. His songs are in direct contrast to the complexity of his orchestral works and abound in simple and yet characteristic melody. Strauss' four operas, 'Guntram,' 'Feuersnoth,' 'Salome' and 'Electra,' are laid out on the broadest lines of any since Wagner.

Among other modern German composers are Wolf, Schilling, Huber, Mahler, Humperdinck, Weingartner, Reger, Korngold, Pfitzner, and Schönberg (qq.v.). Of these Arnold Schönberg is the only really first class composer. A general review of German music by Pierre Lalo, the Parisian musical critic, son of the composer of 'Le' Roi d'Ys,' is interesting for comparative value. Lalo's professional duties called him to Germany annually for 20 years. Writing in 1915 and deprecating the decline in German musical taste marking its modern standards, he remarks: "During 150 years Germanic countries produced a great number of magnificent musical geniuses, and during those years no other country could rival them. But it was only during that period; in the Middle Ages music was Italian, not German; at the Renaissance, it was French and Flemish; in the 17th and to the middle of the 18th century it was sometimes Italian and sometimes French. It is only with Handel and Bach that the greatness of German music begins — and it has ended with Wagner."

A closing word must be said about the great array of critics, biographers, historians and teachers which Germany has produced. Such men as Jahn, Spita, Pohl, and Chrysander in their well-known biographies; Ehlert, Hanslick, and Ambros as critics; Haupt, Jadassohn, Rheinberger, and Riemann as theorists and teachers have had world-wide influence and are largely responsible for the fact that Germany up to the outbreak of the European War in 1914 was the chief centre of a comprehensive musical activity.

Bibliography.— Ambros, 'Geschichte der Musik'; Dickinson, 'The Study of the History of Music'; Eitner, 'Quellen-und Hilfswerke Heim Studium der Musikgeschichte'; Ellis, tr., 'Wagner's Prose Works'; Finck, 'The Life of Wagner'; 'Famous Composers and their Works'; Grove, 'Beethoven and his nine symphonies'; Grove, 'Dictionary of Music'; Hadow, 'Studies in Modern Music'; 'Handbuch der musikalischen Litteratur'; Henderson, 'How Music Developed'; Helmholtz, 'Sensations of Tones'; Krome, 'Die Anfänge des musikalischen Journalismus in Deutschland'; Lavignac, 'Music and Musicians'; Mason, 'Beethoven and his Forerunners'; Naumann, 'History of Music'; Newman, 'Glück and the Opera,' and 'Musical Studies'; 'Oxford History of Music'; Parry, 'Evolution of the Art of Music'; Riemann, 'History of Music,' and 'Präludien und Studien; gesamelte Aufsätze zur Asthetik, Theoria und Geschichte der Musik'; Ritter, 'Allgemeine illustrierte Encyklopädie der Musikgeschichte'; Rowbotham 'The Troubadours and Courts of Love.'

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17. GERMAN KULTUR. The meaning of the word kultur cannot be defined with too great care because the Germans themselves use the word with entirely different meanings in different connections. What the German people understand by German kultur to-day involves an idea which the word kultur did not suggest at all a quarter of a century ago and the different stages of the development did not bring into disuse the older meanings of the word. On the contrary, in the texts of to-day the word kultur is used in its various shades and this may easily lead to misunderstandings. A sentence which would be reasonable and modest with one meaning of the word, torn from its connection, would impress the reader as preposterous when a different meaning is substituted. Originally the German scholars took kultur as the totality of the forms and products of national life. In this sense they spoke of kulturgeschichte. It was the history of everything which social groups and individuals have produced since the dawn of socialized life. Language and customs, religion and law, commerce and industry, art and science, literature and life forms were all held together by the general term kultur. Hence it was no merit to have kultur: even the most primitive tribe of savages or the most degenerate and superstitious people must have some kind of religion and life form and language and accordingly possess kultur.

The first differentiation consisted in a narrowing of the conception. Only a complex and highly developed civilization was acknowledged as real kultur. The savages lacked such complexity of life forms and social products and were therefore said to have no kultur, while between those primitive tribes and the most highly civilized nations stood the peoples with half-kultur. Then came, at about the end of the last century, a new and very characteristic shading. The Germans began to separate those elements of civilization which had a material, practical, technical character and those other elements which are more spiritual and moral and æsthetic. Only the latter were now called kultur, while those more practical ones were held together by the word civilization. Writers who accepted this use began to discriminate carefully among factors which in the earlier use of the word kultur were mixed. Art, literature, science, religion and law were true kultur, while industry, commerce, transportation and similar traits of civilization were outside of true kultur. At this stage it was not unusual to read in German books that, for instance, the Australians have a high civilization but no kultur, because their technical life is as complex as that of any nation, while their art and science and literature are simply borrowed from other peoples. No doubt much of the discussion of the world concerning German kultur has hinged on this meaning, as peoples other than Germans began to doubt whether the contribution of the German people to art, science, literature, scholarship, music and morals were equal to those of England, France and Italy. When the Germans pointed to Goethe and Schiller, to Leibnitz and Kant, to Bach and Beethoven, to Luther and Dürer, to Hegel and Humboldt, and all those other leaders of German kultur, the last defense of the critics was usually the claim that at any rate since the middle of the 19th century and still more since the foundation of the Prussianized German Empire, the stream of kultur has become shallow. The Germans pointed out that on the contrary it was a period in which scholars like Mommsen and Harnack, scientists like Helmholtz, Roentgen, Koch and Ehrlich, poets like Hauptmann and Suderman, artists like Boecklin and Leibl, musicians like Richard Strauss and Mahler, have created works not surpassed by the productive minds of the same generation in other countries. Above all, they showed that this recent period was unfavorable to the production of great individual creations and was much more an age of socialized work and common production, characterized by a new rising of the intellectual and æsthetic level all around. And here, they insist, Germany's achievement was most remarkable. On German soil the artistic city development and architecture showed more originality than in any other land; music and arts and crafts were flourishing; lyric poetry and the drama found new forms of expression.

To understand this last phase, we have to turn once more to the difference between kultur and civilization. We said that the technical products are not kultur, because they are practical, while the other elements have spiritual value. But there is a deeper trait. All those practical, technical achievements, those devices and inventions, are not bound up with the life of a nation. They can be imported. They are not expressions of the people's soul, while the songs and melodies, the morals and beliefs have grown from the bottom of the national soul. This leads to a more essential differentiation. We might say now: true kultur is only that which is an expression of the national consciousness. We may go one step further. True kultur is characterized by creations which are produced in the service of the national consciousness. We can enlarge this definition. Everything which is simply controlled by selfish personal desires, by individual longing for pleasures and advantages, by the chaotic chance production of independent persons, has nothing to do with true kultur. The real kultur exists in the service of individuals to those aims which belong to the national consciousness as such. This national consciousness comes to its organized expression in the state. Hence only through the state does the individual recognize the aims of the whole national unit. To be sure, the state must then be more than a mere protecting agency, a mere mechanism which secures the safety of the individuals. The state must then really undertake the guidance of the individuals toward the highest achievement in the service of the community. The state must aim toward the raising of the level of national production. In short, the state must organize the whole national life in such a way that the individual becomes able and willing to help toward the realization of the national ideals. This is the idea of German kultur in that newest formulation. As soon as kultur is taken in this sense, it is no longer confined to the spiritual goods, but all the practical and technical work in the frame of the nation becomes just as much a part of kultur as this too may be carried out not from individualistic motives but as service to the community.

It was not by chance that this ideal took hold of the German nation during the last century long before the word kultur became adjusted to it. Various historic conditions favored it. The Germans were a poor nation on poor soil. Only the greatest economy and the most energetic industry could lead them to success. In the training school of centuries they had had to learn the lessons of frugality, of saving and of hard work. All this means self-discipline and self-denial, and a people which has learned this lesson is prepared for that stage of kultur in which the individual is to subordinate himself to the will of the totality. The teaching of the great philosophers, notably Kant and Fichte, intensified this attitude. You can because you ought, is the centre of their philosophy. The obligation of the ought as against the mere satisfaction of individual desires is the core of their speculation. This national trend became stronger under the hardship of the Napoleonic age. In the suffering of that time only one salvation was possible; the individual must subordinate himself with his whole soul to the soul of the state. But one other factor must not be overlooked. Throughout the 18th century the Prussian kings had turned their whole energy toward the development of a civil service in which their ideal aims were embodied. The entrance of the best elements of the nation into the civil service became a tradition of the state. The existence of such a model civil service was the practical condition for the firm organization of the national will to which the individual could subordinate himself with an enthusiastic and loyal confidence. All these elements worked together throughout the 19th century, and when the German Empire was founded filled the whole people with the one controlling idea that the richest meaning of life lies in the devotion of the individual to the aims of the state which organizes the activity of the whole nation. Discipline and respect for authority were the guiding principles of education in the school and in the home; willingness to serve in the army was a matter of course for every adult; but at the same time the state as such developed those systems of insurance by which every individual was enabled to serve the common life protected against sickness and accident and the consequences of old age. A thorough organization of the social life and a devoted confidence in the goodwill of the state had to work together to secure that efficiency by which Germany with its small natural resources enjoyed an unparalleled development of its world commerce and of its industry. This spirit of subservience of individuals to the organized will of the national community is the true meaning of German kultur in that latest phase of the world discussion.

To arrive at a clear understanding of the development of kultur it ought not to be overlooked that the reference to the state is not at all essential for the principle of German kultur. The essential feature is that the individual subordinates himself to the organized will of the community, but it is only secondary and to a certain degree accidental that this organized community is the state which embraces a total nation. The organization of the state is, of course, the firmest, but the principle demands just as much subordination where other groups, either smaller or larger, are in question. It is true that according to German kultur ideas the state does not exist on account of the citizens but the citizens on account of the state. But with the same right it may be said that the city does not exist for the individuals but the individuals for the city. And the most important consequence of this is that the principle demands the same devotion when the social group is larger than the single state, as soon as the will of this larger group has really found a firm organization. If a number of states form a federation, German kultur would demand that the individuals serve this federation, if it is firmly organized and really conscious of its aims, with the same devotion with which each citizen serves his single state. Hence the principle of German kultur, however much it accentuates the idea of nationality and statehood, in no way interferes with the idea of international organization and with the building up of a world federation. It would only demand that this larger group become really conscious of its aims in order that it offer guidance and goal to the will of the individuals and not leave them to the mere fancies of their selfish desires.

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18. GERMANY'S ECONOMIC ORGANIZATION. In the territory which now comprises the German Empire there were only about 16,000,000 inhabitants in the year 1816. When the empire was founded in 1871, the population was 41,000,000; when Kaiser Wilhelm II came to the throne in 1888, it was 48,000,000 and 25 years later, in 1913, it was 66,000,000. The rapid increase in the latter period was due very largely if not wholly to Germany's highly developed economic organization.

Political Organization.— To understand the wellsprings of that organization it is first necessary to consider Germany's political organization, as national economic organization is always dependent ultimately upon political organization.

When Bismarck welded the German Empire together in 1871, he provided Germany with a political organization which has proven highly effective and probably far more so than he ever supposed would be possible. When he induced Bavaria, Saxony, Württemberg and the other independent German states to join Prussia in forming the empire, he created in effect a United States of Germany, in which the King of Prussia, by virtue of that kingship became head of the empire. His official title was German Emperor and not Emperor of Germany, a concession to the other rulers who still continued to maintain their regal conditions. In addition to keeping their kings and courts the other states continued their local governing organizations, but they were without any considerable national powers. One of the principal functions which they retained and exercised, however, is highly important, and that is their participation in the Bundesrat, which corresponded in a general way to our American Senate, the members of which, however, were in effect ambassadors from the various states, while the body, further, was the Supreme Court of the German Empire. As the emperor's powers were largely limited, he having no veto and being hardly more than the president of the Bundesrat, that powerful assembly was the real ruling power in Germany.

As King of Prussia, the German Emperor had much greater powers as regards Prussia than he had as emperor in his imperial capacity. And since Prussia's representation in the Bundesrat was 17 votes out of a total of 58, his powers in the appointment of Prussia's representatives in the Bundesrat were accordingly reflected in the policies of the empire, especially since the members from each state voted *en bloc*, under instructions from their respective states, and not as individuals.

Membership in the Bundesrat imparts great prestige to the individual members, and hence the foremost men in the empire are always eager for the appointment. Thus the Bundesrat (the Council of the Bund or Union), being composed of the leading men in Germany and exercising the highest legislative and judicial powers, commands the respect of the nation.

Overlaid like a pattern over the whole empire is the Reichstag, or lower house, the members of which are elected directly by districts, similar to the Congressional districts of the United States. Prussia and the other states have also for local affairs upper and lower houses similar to the legislatures of our American States. The Reichstag is independent of such bodies, however, but has less power than the Bundesrat, its greatest prerogative being the right to veto appropriations.

The Chancellor, who is named by the emperor, must command the confidence of the Bundesrat and Reichstag, and he is the only cabinet minister who is answerable in a political sense to the legislature; the other cabinet ministers being hardly more than department heads. While the Chancellor is appointed by the emperor and while his policies must not be contrary to the sense of the Bundesrat and Reichstag if he is to continue in office, in practice he is much less responsive to the changing currents of politics and maintains himself more readily in office than do the cabinets of other European governments in which the individual ministers must represent policies in accord with those of the legislatures.

Bismarck is thought to have created the chancellorship for himself, and the powers of the office are such that a strong man in the position will dominate even the emperor who appoints him, and be a leader rather than a servant of the legislature. He is furthermore the direct head of the whole bureaucratic system of Germany, which includes, in addition to the usual governmental bureaus, such as consular service, customs, taxes, war, navy, agriculture, post office and the like, the railroads, telegraphs, educational systems and numerous other departments.

The result of the political organization of the empire is that the German governmental system is highly efficient. The high source of authority is the Bundesrat, composed of the best brains of the nation, such as the most prominent bankers, leading business men, administrators, great landed proprietors and taxpayers, eminent lawyers, etc., chosen for their integrity and ability. All problems therefore have the attention, not of politicians whose decisions are dictated by motives of self-interest, but of disinterested patriots who have every possible qualification for the task. Thus, when Germany decides upon a policy it is a policy approved by her best men and not by her demagogues, and it is a policy which commands the respect of the public as being the best that could be adopted. And once a policy is decided upon it is carried into execution with unerring decisiveness. No endless questions of constitutionality are brought up to defeat the will of the people, for the Bundesrat which passed the law is the court which will decide its constitutionality, and is, through the Chancellor as the head of the various departments, the power which will put it into effect. The German system is to centralize authority and to put it into the hands of those who may be trusted. An efficient government system is thus established, with policies determined by the wisest members of the organization and carried into effect by a thoroughly responsive routine organization.

The Economic Factors Outlined.—An outline of its principal factors will demonstrate its thoroughness. The whole system is co-ordinated so that cross-friction is eliminated to the greatest possible extent and every activity of German economy developed to the ultimate degree. Germany's economic organization really begins in the home with maternity insurance and benefits for certain classes of women workers. The infant thus, at birth, is already a beneficiary of the system. The child next feels the good influences of the system in the strict discipline of the German home, which starts him on the path of life with proper respect for his parents and a valuable element of self-control ingrained in his character. The next step is the kindergarten, which gives the child an excellent start for school work. The regular schooling follows, up to a certain point, where the wisdom of the system is shown by the branching off which occurs sufficiently early in life to prevent the wasting of years in studies that will have no bearing on the pupil's later career.

The German educational system recognizes the fact that a large proportion of the pupils must earn their daily bread by the sweat of their brows. The whole student body is not, therefore, started off on a course of study calculated to fit them for the chancellorship, from which the less fortunate ones drop out from time to time into business life and trades as necessity dictates, more or less learned, but the curriculum is so arranged as to lead each pupil to the goal selected for him; that which the circumstances and tastes of his parents dictate. All pupils enter the public schools at the age of five and a half to six years, and all pursue the same studies up to the age of nine, when those intended for higher walks of life diverge into two branches; one curriculum leading to professional careers (medicine, law, teaching, the pulpit, etc.) and the other to technical careers (engineering, chemistry, architecture, mining, metallurgy, etc.), while the main body of pupils, who will not be able to afford specialized branches, continue from 9 years to 14 years in the public schools in a curriculum which is adapted to be of the greatest practical use in later life. The German pupil in the upper public school grades has regularly 1,440 hours of study per year.

After leaving school at 14, the main body of pupils continue for three years (6 to 10 hours per week) while employed, to attend continuation schools, in which special studies fitting them for particular trades and commercial positions are carried on, as well as certain general studies. Both the public school and continuation school courses are compulsory. Those taking courses for professional and technical careers continue from the 9th to the 15th and 16th years in the middle schools and then pass into the high schools for four years more, when at the 19th and 20th years they are ready for the universities, in which four years or more are spent. Meanwhile, beginning at the 15th year, certain pupils destined for professional careers as officers have left the middle schools and gone into special academies, both military and naval, though from time to time at later periods in the school life (usually at the 20th year) pupils also have the option of entering the military and naval branches for careers as officers. In the case of pupils taking up technical careers, one year's shop or field work is required prior to entering the university.

Military service is for one, two and three years, in accordance with circumstances. Those who go through the high schools serve but one year, but have to pay all their own expenses. In addition, as a special stimulus to industry and the arts, those who attend only the public and continuation school grades, if they attain special excellence in their callings, are permitted, if they are able-bodied, to volunteer for one year's service instead of being called to the colors compulsorily. However, as there are many more able-bodied citizens than are required for the standing army, only about 58 per cent serve, a considerable portion of whom are volunteers. The army service itself has great educational value in the sense of forming character and habits of discipline. This together with the added incentive which it provides for the schools in general makes the military service a highly valuable factor in German economical development, irrespective of its military importance.

Upon leaving the primary schools the German youth becomes an apprentice in the trade which he selects. As a rule he is paid a small wage, though in some instances he must work for nothing and in certain trades, such as that of the goldsmith, he must pay a substantial sum, often as high as 4,000 marks, and in other instances must bind himself for a term of years, in order to gain the privilege of learning the trade. He may also have to agree not to seek employment in certain districts within specified periods and not to become an employee of a competing concern. But because a youth leaves school early on account of not being able to enjoy the advantages of high school education does not by any means block his subsequent progress. After he has learned his trade, attended continuation school and become a journeyman, he may at a later date become a master workman and be entitled to engage in business on his own account, employing other workmen. His further rise then depends upon his ability, and he may eventually be employing as technical experts his apparently more fortunate companions who were able to take the higher branches of education.

The German system sees to it that every youth is given an education and is equipped with a thoroughly mastered trade or profession, and thus the individual is made self-reliant and a useful member of society. As the master workman must pass a state examination before being allowed to engage in business on his own account, it is obvious that the public cannot be practised upon by fakirs and incompetents as no such persons have licenses to engage in business. Bismarck laid down the principle of the right to work and he embedded it in the German economic system in such a way that every man who is willing to work need never go hungry. To carry the principle into effect, the state first conducts employment bureaus to the number of over 300, in different parts of the country. Over a million positions annually are filled in this manner and the man and the job are thus brought together. The labor exchange in Berlin was established in 1888 and finds employment annually for over 100,000 persons at an operating cost of $25,000.

The right to work is not interpreted to mean that every man must be provided continuously with a highly paid position, a thing beyond the powers of any state, but it is regarded as meaning that the state's duty is to provide temporary opportunities for work during periods of industrial depression, which will serve to tide the workman over. The work provided by the state in Germany at such times is on public enterprises which may thus be constructed without drawing labor from other fields of industry. In the conduct of such enterprises, it has been found, however, undesirable to offer wages much below the prevailing rate, on account of its demoralizing effect upon industrial conditions in general. The right to work is a principle which has, however, a broader application than the mere phrase implies. It applies not only, as indicated, to the providing of employment bureaus and of actual work in times of depression, but also among other things to the safeguarding of the interests of the worker in his position. The principle does not extend, of course, to the point where the worker may be regarded as having a vested right in his position, but once he has a position, he is guaranteed against sudden termination of the work and against impositions on the part of the employer. This is accomplished largely through the industrial courts which are preliminary or informal courts in which minor matters of dispute are considered. Every city of 20,000 or upwards has one or more of such courts, of which there are about 500 in all Germany. In the year 1908 the number of cases in the industrial courts was 112,281. Such courts are prompt, economical and efficacious. Over 90 per cent of the cases brought in them are so adjusted and only 7 per cent are appealed to the formal courts. One and one-half per cent of the cases last over three months and the costs are only those actually incurred. Such proceedings are more in the nature of arbitrations than of court actions, but they are very effective since business men and employers do not like to have a record of being continually haled before the court. Employers also resort to the industrial courts, though not by any means to the extent of the actions taken by employees. In 1908, of 14,522 cases brought in the industrial courts of Berlin, 702 cases were brought by employers and 13,820 by employees. The economy and ease of taking such action is highly beneficial, since both employer and employee, knowing that unjust and oppressive actions can be so quickly brought to book, are more careful to act justly and equitably.

In pursuance of the policy of the right to work, the German workman is given every incentive to remain permanently in his position, and there is accordingly little changing from position to position. This German tendency to stick to the job has the effect of stimulating German industry as a whole in a marked manner, since the workingman, expecting as he does to remain permanently with the one firm, becomes more diligent in promoting the firm's business than if he expected to remain only a short time, since his own continued prosperity depends on the firm's prosperity. The German workman also is induced to remain permanently in his position through contributions to accident, sickness and other insurance and pension funds. To change his position then means a loss of money and seniority of benefits so that it is often more lucrative to remain than to change.

German concerns of large size often build garden cities and erect workingmen's homes which are rented or sold to their workmen on very favorable terms, while residence in such garden cities or workingmen's villages is more economical than residence elsewhere, through the purchase of supplies in bulk and the operation of company's stores or of communal co-operative stores.

Workingmen's Insurance.— An especially important feature of Germany's economic organization is her highly developed systems of workingmen's accident, sickness, invalidity and other forms of compensation insurance. Both employers and employees are obliged by law to contribute to such insurance funds, and the result is that a German workman, when injured or ill, is not left without assistance, nor his family in distress, at the moment he is incapacitated.

Compensation insurance has reached an enormous state of development, over 50,000,000 policies being in force, although there are not that many individuals insured since many are protected by more than one kind of policy. In 1910 the premiums which had been paid to workers since the inception of the system amounted to over $2,000,000,000, while over 95,000,000 cases of sickness among the insured had occurred. The following table shows the vast extent of compensation insurance:

Co-operative Loan Societies.

Germany, 1911	952 Schulze-Delitzsch Co-operative Societies	Other Co-operative Societies (Co-operative Societies Statistically Included)
Members	620,660	1,755,175 (15,473)
	Million Marks	Million Marks
Loans granted during the year	4,428	1,945 (13,642)
Debtors at end of year	1,285	2,154 (13,800)
Deposits by members	226	102 (15,473)
Reserve funds	99	93 (15,473)
Outside creditors	1,223	2,685 (13,872)

A form of communal co-operative activity which forms an important factor in Germany's economical development is that of Consumers' Unions. As will be seen from the table there are some 2,300 co-operative stores which are the retail selling depots of the Consumers' Unions. The principle upon which this form

Compensation Insurance.

Form of Insurance	Number of insured in 1910	Compensation paid to workers: Since beginning (In million marks)	Compensation paid to workers: 1910 (In million marks)	Number of cases in which payments have been made: Since beginning	Number of cases in which payments have been made: 1910
Sickness insurance	13,955,000	4,352	357	92,582,319	5,704,429
Accident insurance	24,154,000	1,973	164	2,273,130	1,017,570
Invalidity insurance	15,660,000	2,068	197	5,060,300	1,335,697
Total	....	8,393	718	99,915,749	8,057,696

Co-operative Societies.— The value of Germany's policy of economic organization is shown by the great number of co-operative societies and organizations which are in existence, largely the result of encouragement by the governmental departments. The tremendous effect of such widespread co-operative endeavors is obvious and is one of the important factors in Germany's progress. There are some 32,000 co-operative societies with about 5,000,000 members, of which two-thirds are agricultural in character. The most important of the societies, however, are the co-operative loan societies, numbering over 18,000 and having a membership of 2,500,000 with an annual turnover equivalent to six and a quarter billion dollars. The increase of co-operative societies in the past generation is surprising, as will be seen from the following table:

Number of Co-operative Societies.

Form	1880	1911
Co-operative loan societies	1,895	18,126
Co-operative trade societies	333	1,961
Co-operative agricultural societies (1895)	2,956	7,089
Co-operative stores	645	2,355
Miscellaneous societies	......	1,920

The great volume of business of the co-operative loan societies may be seen from the following table, divided between the Schulze-Delitzsch and other co-operative societies:

of co-operative activity is based is that of wholesale purchasing for the benefit of the consumer-members. The members of a consumers' union pay a small annual fee for their membership cards in the union and they then patronize the union's store, paying cash for their supplies. The manager of the store collects information from the members from time to time as to what their probable needs will be during ensuing seasons for the various kinds of products. This information he compiles and uses as a basis for the wholesale purchases of the store. In this manner the store is able to order the proper quantities of produce and knowing in advance when it will be required can always order to the best advantage. As various stores unite into general organizations and increase further by the establishment of additional stores and local unions, the purchasing power of a group of stores becomes very great and the produce needed is thus obtained on the most favorable terms possible. The unions issue bulletins or small newspapers periodically, giving prices and market conditions and advising members of opportunities to make favorable purchases. The bulletins also contain recipes for cooking and other information of benefit to the members.

The unions do not attempt to make a profit but sell as nearly as possible at cost plus overhead charges and expense of handling. A small surplus accumulates, however, on account of the margin being kept on the right side. This margin is distributed to the members as an annual dividend in proportion to the aggregate amount of their purchases. This distribution usually occurs just before Christmas and serves as a fund for the purchase of Christmas presents. The popularity of consumers' unions is very great and they perform a considerable service, not only reducing the cost of living to their members but in acting as a standard by which the patrons of other stores may judge whether or not they are being overcharged.

The German government, through its health officers and through stringent regulations, ensures to the public a high standard of food products free from adulterations. The German economic system does not stop, however, with providing work and guarding the public health and purse, but continues even to the supervision and management of various forms of amusement for the public. A considerable part of this work is done by municipalities rather than by the general government and each city has officials who have charge of public amusements in the parks and playgrounds where athletic contests and games are conducted and all sorts of outdoor sports encouraged. The cities also subsidize theatres and theatrical companies, which enables theatrical performances and operas to be given at extremely low prices. Such performances are regarded as of educational value and it is no more expected in Germany that the classics of music and drama will pay their own way than that the public schools could be conducted by charging admission. In addition to dramatic and operatic performances, the municipalities supply concerts and lectures of various kinds and the public thus has a wide variety of recreations to draw upon. The direction of such recreations is recognized as a definite occupation and is placed in the hands of experts.

The Birthrate and Immigration.— Germany's prosperity has had the effect of decreasing her birthrate, a practically invariable result of national prosperity, though this universal law has had much less effect in Germany than elsewhere. The reduction of the deathrate, however, has been much more rapid so that the net result has been favorable. From 1871–80 to 1901–10 the number of births per 1,000 inhabitants dropped from 40.7 to 33.9, while deaths dropped from 28.8 to 19.7, with the result that the birth excess increased from 11.9 to 14.3, this being due to decrease of deaths more than to the birth figures. From 1871 to 1880, however, was a post-bellum period during which there is naturally a large birthrate. Although the rate of increase is not as favorable as might be desired, a comparison with the figures of immigration shows in a true light the prosperity of Germany. In the decade 1881–90 there were 1,342,000 German emigrants as compared with a total birth excess of 5,500,000; in the following decade there were 528.000 emigrants to 7,300,000 birth excess, while in 1901–10 there were but 220,000 emigrants (an average of 22,000 per year) compared to a birth excess of 8,670,000. In 1912 the number of German emigrants was 18,500, while in 1913 it was but 13,000. The position of Germany, too, is seen to be much more favorable, when immigration is considered, for since the middle of the nineties there has been an excess of immigration over emigration.

Savings Bank Deposits.— The remarkable efficacy of the German economical organization is reflected in savings bank deposits. In 1910 there were 21,534,000 savings bank depositors in Germany, whose deposits aggregated 16,780,500,000 marks, or an average of $64 per capita for the entire population, including non-depositors. The savings bank depositors of the United States numbered 9,143,000 and had on deposit the equivalent of 17,096,000,000 marks, an average of $46 for the whole population, while the depositors of Great Britain numbered 13,209,000 and had on deposit the equivalent of 4,422,300,000 marks, an average of $24 per capita, and France had 14,069,000 depositors with deposits equivalent to 4,514,500,000 marks, an average of $28 per capita.

Germany's Technical Organization.— The underlying technical principle of Germany's economic organization is the development of her resources in population and the sale of their products; that is to say, she develops the laborer into the skilled artisan and then utilizes his skill in transforming low grade raw materials into highly valuable finished products. The principal export of Germany, accordingly, is the skill of her artisans and technicians, the raw material plus the skilled labor-technique content. As Germany's population is increasing rapidly, at the rate of about 1,000,000 per year. there is thus no limit to the prosperity that may be attained. The part that is played in the development of Germany's resources in skilled labor by her technical organization is of paramount importance, for skilled workmen would not be so great an asset without inventors and technicians to devise and improve manufactures and processes for them to carry into execution. Germany accordingly devotes great attention to the subject of technical and scientific education. Technical training is begun early in the school life and there are a large number of technical schools, high schools and universities, the latter having world-wide reputation as the foremost institutions of their kind. In addition, the government maintains testing laboratories and research institutions while large concerns have staffs of investigators, inventors, scientists and technicians constantly at work in producing new inventions and processes.

The patent system of Germany is adapted to give the greatest possible protection to the work of inventors and the banking system to extend adequate financial encouragement, so that no man in Germany with an idea need let it remain unused. On the contrary, every man who is capable of producing new ideas meets with every possible encouragement. The great technical and scientific activity of Germany is shown by the number of scientific books published which amounted to 10,400 volumes in the year 1910.

Illiteracy.— Another evidence of the effectiveness of Germany's system is seen in a comparison of illiteracy in the various countries. There is practically no illiteracy in Germany, it being less than .02 per cent. The number of illiterates in Belgium is 10.2 per cent; in France, 14 per cent; in Great Britain, 13.52 per cent;

in Italy, 30.6 per cent; in Austria, 26 per cent; in Hungary, 40.9 per cent; in Russia, 61.7 per cent; and in the United States, 7.7 per cent.

Bibliography.— Helfferich, Dr. Karl, 'Germany's Economic Progress and National Wealth' (Berlin 1914); Koester, Frank, 'The Price of Inefficiency' (New York 1913), and 'Secrets of German Progress' (New York 1915); Dresdner Bank, 'Germany's Economic Forces' (Berlin 1913); 'Deutschland als Weltmacht' (Berlin 1911).

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19. GERMANY'S NATIONAL WEALTH. For many generations the poor neighbor nation of Europe, Germany after 1890 acquired wealth and prosperity. The increase of wealth is indicated by the savings bank deposits. In 1888 they amounted to $1,137,500,000 while 25 years later they had grown to $4,500,000,000, an increase of nearly 400 per cent.

During the same period the total turnover of the Reichsbank (Germany's governmental central bank) including checks and discounts increased from $19,950,000,000 to $103,500,000,000, while the turnover of the Deutsche Bank, the largest private bank, increased from $4,525,000,000 to $33,050,000,000. Bills of exchange increased from $3,000,000,000 in 1887 to $8,500,000,000 in 1912. The expansion of internal trade is shown by the increase of the post office receipts from stamps and telegraph messages from $47,500,000 in 1887 to $196,000,000 in 1911. The total deposits in banks and other institutions of deposit were $1,625,000,000 in 1888, but by 1913 the aggregate was $7,500,000,000.

A collateral evidence of the growth of wealth in Germany is seen in the increased consumption per capita of products of various kinds. At the close of the Franco-Prussian War the general standard of living was low and there were few large cities. Modern standards of living were confined to the well-to-do and frugality was the necessary virtue of the times. The increase of wealth was accompanied by increasing demands for better living conditions. A comparison with the increases of other countries shows that from 1886 to 1906 the consumption of wheat and rye in Germany per capita increased 39 per cent, in the United States 28 per cent, in Italy 18 per cent and in Austria-Hungary 16 per cent, while the consumption in Great Britain remained stationary and in France decreased 4 per cent. In barley, oats and potatoes Germany's increase per capita was 70 per cent, 39 per cent and 49 per cent respectively. For the consumption of meat, statistics are less completely available, but indicate a consumption (1912) of 51.9 kilogrammes (113 pounds) per capita. This compares with the figures for 1904 in Great Britain. Between 1890 and 1904 the British consumption increased from 99 to 114 pounds per capita. There was in 25 years no increase per capita in the consumption in Germany of alcoholic beverages or of tobacco. The per capita consumption of sugar, although it increased from 14.9 to 41.8 pounds per capita from 1885 to 1911, remained far behind that of other countries, whose increases were as follows: Russia, from 8.1 to 22.2 pounds; Austria, from 11.2 to 28.6 pounds; France, from 25.9 to 42.5 pounds, now equal to Germany's; the United States from 49.3 to 79 pounds and Great Britain from 70.2 to 90.4 pounds. In cotton there was an increase in Germany of from 9.2 pounds per capita in 1886 to 13.4 in 1912.

A number of estimates of Germany's national wealth and income have been made from time to time and these estimates accord within reasonable limits. Any estimate of national wealth and incomes must naturally be more or less approximate, as many factors escape statistical review, but the means of checking the figures which are available prove that the final results are reasonably accurate. The returns of the income tax provide a means of estimating the private income of the citizens in general. The figures are taken from 1896 onward as the income tax was not established until 1892 and several years were required to get it into normal operation. The income tax in Prussia is more stringently enforced than in the other two-fifths of Germany, and furnishes a more exact index of incomes than do any other returns. The result of Prussia's assessment for 1912 showed aggregate taxable incomes of $3,810,000,000. The incomes of those exempt from the tax and of those whose incomes were too small to be taxed amounted to about $1,785,500,000. These two items aggregate $5,595,000,000. An addition of 10 per cent is considered proper to cover taxable incomes which evade taxation, which would amount to $381,000,000. A further addition should be made to cover earnings placed in reserve by corporations, instead of being declared in dividends, which is estimated at $55,000,000. The total for Prussia would thus be about $6,000,000,000. The population of Prussia being about 40,000,000, the average income on this basis would be about $150 per annum, or for a family of six, the average size, $900 per annum.

In Saxony and the Hansa cities incomes are higher, while in Baden, Würtemberg and the Thuringian states they are lower, but on the whole the average throughout the empire is about equivalent to that of Prussia. Applying the Prussian average to the whole population the grand total of private income would be from $9,750,000,000 to $10,000,000,000 per annum. To the total of private incomes should be added the net income of public corporations, or about $250,000,000 more, so that the income of the citizens and corporations amounts to fully the estimated figure of $10,000,000,000. It should be noted that dividends are included in the private income, rather than as corporation net income. A calculation for the year 1896 would show an analogous income of $5,375,000,000 or about $102.50 per capita. The increase of the aggregate income during the 16 years therefore amounts to about 80 per cent, while the increase of the average per capita income is about 45 per cent.

The income of the French people was estimated some years since at $6,250,000,000, at a time when the German income was about $8,750,000,000. Taking the year 1908 as normal, the average income of the German people would be $138.75 (555 marks) as compared with $128.50 (514 marks) for the French people.

The English national income was estimated, some years since, at about $8,750,000,000, or exactly equal to that of Germany at the time

Thus the average English income would be $203.75 (815 marks) per capita as compared with $138.75 per capita for Germany.

The statistics of savings banks for 1910, however, show that Germany had 21,534,000 depositors with an aggregate of $4,195,125,000 on deposit, an average of $64 per capita, for the whole population, while Great Britain had 13,209,000 depositors with an aggregate of $1,055,575,000 on deposit, an average of $24 per capita, while France had 14,069,000 depositors with deposits of $1,128,625,000, an average of $28 per capita, and the United States had 9,143,000 depositors with an aggregate of $4,274,000,000 on deposit, an average of $46 per capita.

An illustration of the increase of wealth in Germany is seen in the number of those who have passed into the income tax paying class in Prussia, which is representative of the whole country. The number of persons with incomes of $225 or below decreased from 8,614,000 to 8,159,000 in the period from 1896 to 1912. The number of taxpayers with incomes above $225 rose from 2,859,000 to 7,542,000. There were thus about 500,000 fewer low-incomed persons and about 5,000,000 with higher incomes. The number of persons exempt from the tax, including their dependents, fell from 21,066,000 to 16,005,000, but the number of taxpayers, including their dependents, increased from 10,283,000 to 24,232,000. Thus while more than two-thirds were exempt from the tax in 1896 because their incomes did not reach the minimum tax limit, in 1912 less than two-fifths were exempt.

The increase of those taxable indicates the prosperity among those whose incomes are in the lowest classification, but a striking proof that wealth is equitably distributed in Germany is shown in the increases in the next two classes, those whose incomes range from $225 to $750 per annum and those whose incomes range from $700 to $1,500 per annum; that is to say, the middle classes. For a just comparison the fact should be borne in mind that the purchasing power of the dollar in Germany is almost double that of the dollar in the United States. In these two groups the increase of income since 1896 has been about $1,700,000,000, while the aggregate increase of all taxable income was about $2,250,000,000. The middle classes have thus absorbed the larger part of Germany's prosperity. In 1896 the number of persons in the class $225–$750 was 2,321,000 and they had incomes of $799,250,000, while in 1912 they had increased to 6,123,000, with incomes amounting to $2,146,000,000. In 1896 the number of persons in the $750–$1,500 class was 215,000, with incomes aggregating $218,500,000, while by 1912 this class had increased to 548,000, with incomes aggregating $536,000,000. Thus these classes enjoyed two and one-half fold increases.

In higher classes the increases were not so large, but it is to be noted that the increases in the $750–$1,500 group was lessened by those who passed to the next higher state. In the highest group of all, those having incomes of $25,000 or over, the total in 1896 was 1,700 persons, with aggregate incomes of $100,000,000, while in 1912 this class had 4,500 members with aggregate incomes of $273,500,000.

That the increase in incomes in Germany was not due merely to more rigorous assessments is shown by the fact that wages have similarly increased. As an example, the wages of coal miners may be taken. In 1888 in the Dortmund district the average yearly wages were 863 marks ($215) and in upper Silesia 516 marks ($129). In 1913 the figures had increased to 1,586 marks ($396.50) and 1,053 marks ($263.25) respectively, or in one instance more than double. The figures are net as payments for insurance averaging 204 marks ($51) per annum are deducted. Other wage figures demonstrate the same truth, that Germany's wealth is widely distributed.

The yearly income of all Germany of $10,000,000,000 is the gross result of Germany's economic activity. To obtain the net result it would be necessary to deduct the amount consumed each year, the greater part of which is used in meeting living expenses and in state administration. Although the state expenses might be ascertained, it is not possible to estimate private expenditures, so that to find out the amount of Germany's annual surplus it will be necessary to ascertain the annual increase of the national wealth, which can be estimated within reasonable limits.

A preliminary basis for estimating national wealth is to be found in the property tax assessment. The following table shows the increase in tax assessments for Prussia from 1896 to 1911:

YEAR	TAXABLE PROPERTY	Increase	
		Total	Per annum
1896.....	$15,894,500,000	....	....
1899.....	17,510,500,000	$1,616,000,000	$538,750,000
1902.....	18,912,500,000	1,402,225,000	384,000,000
1905.....	20,602,500,000	1,689,750,000	563,250,000
1908.....	22,913,250,000	2,310,750,000	770,250,000
1911.....	26,014,250,000	3,104,000,000	1,117,000,000

The taxable property of Prussia was thus in the year 1911 $26,000,000,000. Allowing an addition of 20 per cent for unassessed property, since no declaration is required and since landed estates are returnable at a value estimated on net income and not on property values, and further additions for tax exempt properties; for those which are exempt when the owner's income is below 900 marks ($225); for furniture, clothing and household utensils and for certain other properties, the total amount of private property in Prussia may be fairly estimated at $40,000,000,000, which is an average of $1,000 per capita for the whole population. Assuming the same ratio for the other states, the total of private property for the whole of Germany would be $65,000,000,000. To the private property must be added the value of the state railways, estimated at some $5,000,000,000 to $6,250,000,000. In addition must be included the property of the states and municipalities which are engaged in many enterprises, such as mining, forestry, canals and river improvements, post-office, telegraphs, gas, electric and waterworks, public insurance institutions and the like, schoolhouses, administrative buildings, etc., and the property of the army and navy. A conservative estimate of these assets would be from $6,250,000,000 to $7,500,000,000, so that the total assets of the empire, states and communities, would be about $12,500,000,000, from which, however, $6,250,000,000 should be deducted as representing the public debt. Adding the public property to the private property the grand total of $71,250,000,000 is obtained.

A valuable check on this estimate which proves that it is low rather than high is seen in the insurance on real and personal property carried by German policyholders.

tions of foreign companies and various agricultural, industrial and commercial undertakings conducted by Germans, have been variously estimated, holdings of securities alone being estimated at from $2,500,000,000 to $3,500,000,000; but the total of all foreign interest may be conservatively put down at $5,000,000,000.

It will thus be seen that while the estimate of Germany's wealth based on the property tax yielded a total of about $71,250,000,000, the second method, which mainly uses the fire insurance statistics, gives a total value of $83,000,000,000. It may be assumed that the actual

INSURED VALUES (In millions of dollars).

YEAR	In public institutions	In joint-stock companies	In mutual associations	Total	Increase	
					Total	Per annum
1896	10,725	15,760	2,840	27,235	....	....
1902	13,766	20,164	3,072	37,003	7,678	1,279
1905	15,290	23,411	3,646	42,242	5,244	1,748
1908	17,369	27,203	4,017	48,592	6,342	2,114
1911	19,842	30,905	4,500	55,249	6,659	2,219

These figures include some $5,000,000,000 carried by German companies which must be deducted, being insurance on property outside of Germany, leaving a total of $50,000,000,000 for real and personal property in Germany covered by insurance. This is a very conservative estimate since no addition is made for German property abroad insured outside of Germany. It fails also to include property not insured or inadequately insured. Furthermore, it cannot include land values which are not insured. Estimates of the value of land vary greatly, ranging from $12,500,000,000 to $25,000,000,000.

The value of land in cities based on an estimate of the land value of Berlin at from $1,750,000,000 to $2,000,000,000 would indicate for all German cities a value of $7,500,000,000. Agricultural lands and forests in Germany amount to about 50,000,000 hectares (123,500,000 acres). Of this 26,400,000 hectares (62,208,000 acres) are devoted to fields, gardens and vineyards, about 6,000,000 hectares (14,820,000 acres) to meadows, 2,700,000 (6,669,000 acres) to pastures and 14,000,000 hectares (34,500,000 acres) to forests. An average value of $200 per hectare ($81 per acre) for the land, including all improvements not insured against fire, would show a total value of $10,000,000,000 for all lands outside of the cities. The mining property not insured against fire is valued at $1,250,000,000 to $1,500,000,000. Vessels in inland and seagoing commerce not insured against fire are valued at $250,000,000, and the value of goods in transit at least another $25,000,000. Metallic money in circulation amounts to about $1,000,000,000. In addition the property of the state railways is not included in the list of property insured against fire, its value being estimated, as stated, at about $6,250,000,000. The same is true of harbor works at seaports and on internal waterways and of certain other public works and properties, such as post office and telegraph facilities and public buildings, which may be estimated at $2,500,000,000 for the group.

Germany's investments abroad, including foreign government bonds, stocks and obliga-

value of Germany's national wealth lies between the two limits or in the neighborhood of $75,000,000,000.

Bringing together the various forms of public wealth, the following result is obtained:

Real and personal property insured against fire	$50,000,000,000
Land in city and country	17,500,000,000
Mining property	1,500,000,000
Shipping, goods in transit and metallic money	1,500,000,000
Public property, including railways, not insured against fire	7,500,000,000
Capital investments abroad	5,000,000,000
Total	$83,000,000,000

In 1895 the national wealth of Germany was estimated at about $50,000,000,000, but since that time the property assessed in Prussia for the property tax has increased in value from $15,894,500,000 to $26,014,250,000 or some 65 per cent, and the real and personal property insured against fire increased in value from $29,325,000,000 to $52,600,000,000 or nearly 80 per cent. Even if one-fourth of such increase be regarded as due to a more rigid assessment and a more complete insurance of property, an increase of national wealth of from 50 to 60 per cent between 1895–96 and 1910–11 would be indicated. If the national wealth of $50,000,000,000 in 1895 be assumed to have increased proportionately, the total would now reach $75,000,000,000 to $80,000,000,000 for 1910–11, a result which is not far from the previously given estimates of $71,250,000,000 and $83,000,000,000. These estimates indicate a per capita wealth of from $1,150 to $1,225 for the entire population of Germany.

The yearly gross profit of the German people, estimated at $10,000,000,000, is to a great but not yet determinable extent absorbed in expenses. The remaining surplus is the yearly increment of wealth, or national savings. A considerable part of the expense or absorption of income is taken up by the governmental expenses. Those of the empire amount to about $750,000,000 and those of the several states to about $1,450,000,000, or a total of

$2,200,000,000. Of this total, however, $900,-000,000 is for railways and other business undertakings of the empire and states, which is balanced by receipts and thus not chargeable as net expenses. The sum of $1,300,000,000 remains as the actual consumption for public purposes. The special expenses of the government in business undertakings also are not properly chargeable against expenditures, as they are merely transactions of a commercial nature.

To the state expenditures must be added the expenses of municipalities and other public corporations and governmental organizations, which amount to about $500,000,000. The total consumption for administrative purposes is thus about $7,000,000,000, or about one-sixth of the gross. This total does not include the contributions for labor insurance, now exceeding $250,000,000 a year, or more than the total normal expenses of the army and navy in times of peace. These contributions partly reappear as national savings or investments and partly as income in the cases of those who receive pensions or aid from the funds. Only the cost of administering the funds, about $20,000,000 a year, should be charged as expense.

The governmental expenses are the only expenses which can be estimated with any degree of accuracy, as personal expenditures cannot be ascertained. Since, however, the national savings appear in certain definite forms, such as new issues of securities, bank deposits, savings bank deposits, co-operative loan societies, etc., a useful estimate may be made by calculating what remains rather than what is spent. In the 27 years from 1886 to 1913 the issue of new stock exchange securities has been from $13,250,000,000 to $13,500,000,000, or some $500,000,000 annually. For the last seven years the increase has been very nearly $750,000,000 per annum. While a considerable part of the new securities represent refunding operations and the transformation of private firms into corporate organizations, there has been on the other hand a considerable investment in foreign securities and in home securities not listed on the exchanges.

The deposits in German credit banks increased from 1895 to 1912 more than $1,875,-000,000, having risen from $442,500,000 to $2,340,000,000; the yearly average having been about $140,000,000. The German savings banks increased from $1,700,000,000 in 1895 to $2,200,-000,000 in 1900 and to $4,450,000,000 in 1911. This is a total increase of $2,750,000,000 from 1895 to 1911, or an average of $172,500,000 a year. The assets of the labor insurance institutions have a yearly gain of at least $125,000,000.

The sum of these items of new issues of securities, bank and savings bank deposits and the increase of labor insurance assets amounts to $1,125,000,000. This sum, however, represents only a part of the increment as it does not include the new capital that goes into the numerous private companies and enterprises that escape statistical notice, nor the ever-growing personal property of the general public. The increasing demands for articles of comfort and luxury as individual incomes increase is also a large factor in the disposition of the income increment. A still further manifestation of the national savings is seen in the increased price of land, especially in growing cities, a form of increment which is unearned as far as the individuals who are the beneficiaries of it are concerned, but which in the eventual analysis is an increment earned by the public in general, and in the main coming into the hands of the fortunate individuals obtaining it through increased rents and the increased cost of merchandise resulting therefrom. In some German states, however, this increment is the subject of a tax. According to the estimates which have been given, about one-third of the total wealth of Germany is represented by the property assessed in Prussia for the property tax, amounting to $26,000,000,000, while two-thirds of the total wealth is represented by the property insured against fire, or some $55,250,000,000.

Using these figures as a basis for calculation and deducting one-fourth as an allowance for a more rigorous assessment and a more complete insurance, the following conclusions are reached regarding the growth of the entire national wealth of Germany. The increase of the property tax from $15,900,000,000 in 1896 to $26,000,000,000 in 1911 was about $10,000,000,000. The increase of the total wealth according to that ratio would be three times as great, or $30,000,000,000. Deducting the one-quarter allowance noted the net sum would be $22,500,000,000, or an average of $1,500,000,000 a year for 15 years. The increase, however, was much more rapid during the latter part of the period, increasing from about $1,000,000,000 a year during the early years of the period to about $2,500,-000,000 a year during the latter part. Estimates of the yearly increase based on the figures for fire insurance show the increase to be somewhat larger. The increase in insurance was from $29,325,000,000 in 1896 to $55,250,000,000 in 1911, or about $26,000,000,000. Adding half this amount and deducting the one-fourth allowance, the total increase would be $29,250,000,000, or nearly $2,000,000,000 per year. The increase during the first few years of the period is a little less than an average of $1,500,000,000 per year while during the last few years of this period the increase is a little less than an average of $2,500,000,000 a year, or very similar to the average shown by the first estimate.

From these estimates it would appear that the annual increase of Germany's wealth averaged from $1,500,000,000 to $1,750,000,000 for 15 years, and that in late years the increase was at the rate of about $2,500,000,000 a year, about one-half of which came into evidence in the new securities and other visible forms of investment mentioned. This includes, of course, as nearly as may be ascertained the unearned increment before mentioned. Various estimates have been made of the total of the unearned increment, the most careful computations placing it at from $375,000,000 to $500,000,000 per year, including all lands and properties to which such value accrues. Deducting this from the previous figures the yearly increase of the national wealth directly earned is seen to be from $2,000,000,000 to $2,125,000,000 per year.

While these figures are as nearly correct as may be it is obvious that no estimate of national wealth can lay any claim to mathematical exactness. The approximation, however, is sufficiently valid to indicate in broad outline the resources, income and capital of Germany. A further factor of uncertainty is the value of money itself which appears to have depreciated to a certain extent all over the world, though not sufficiently to have any great effect on the figures given. From the estimates made, Germany's wealth may be summarized as follows:

The national income amounts to $10,000,000,000 per year as compared to $5,500,000,000 to $6,250,000,000 in 1895. Of this income of $10,000,000,000 about one-sixth, or $1,750,000,000, is devoted to public purposes, and about $6,250,000,000 is consumed for private purposes, while from $2,000,000,000 to $2,125,000,000 (increased to $2,500,000,000 by the unearned increment) is annually added to the national wealth, compared with from $1,125,000,000 to $1,250,000,000 annually 15 years before. The total national wealth of Germany in 1911 amounted to more than $75,000,000,000 as compared to $50,000,000,000 in 1895. These figures demonstrate the strides made by Germany before the war.

Bibliography.— Helfferich, Dr. Karl, 'Germany's Economic Progress and National Wealth' (Berlin 1914); Koester, Frank, 'The Price of Inefficiency' (New York 1913); and 'Secrets of German Progress' (New York 1915); Dresdner Bank, 'Germany's Economic Forces' (Berlin 1913); 'Deutschland als Weltmacht' (Berlin 1911).

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20. GERMAN COMMERCE. History.— Until the beginning of the 19th century the smaller German states and the different provinces of the larger German states were separated from each other by customs boundaries. Not only the states but the provinces being semi-independent the organization of national production was inefficient, commerce small and, over those economic boundaries, restricted to a few articles of high quality or to monopoly products, the standard of living low and consumption limited to what we think now to be almost the necessities of life. But in this way a diversity of production and accordingly a diversity of human interests were kept alive.

Prussia in 1805, under Freiherr von Stein, was leading in breaking up these local economic units by abolishing the customs boundaries which separated her different provinces. By that measure in connection with the development of the means of transportation (building of roads, canals, somewhat later railroads and the introduction of steam power) and the favorable geographic position of Prussia to the most important navigable rivers of Germany, Prussia's economic preponderance amongst the states of the German Federation, as founded by the Congress of Vienna, was secured. In 1833 the economic union between Prussia and the most important South German states was established by the famous Customs-Union (Zollverein), which was extended during the '40s and '50s over almost the whole of modern Germany and became more and more centralized under Prussian leadership.

In fact, the economic union of Germany was well-established before the political union was won, simply by economic necessity and of course sometimes against the sentiments of the statesmen of the middle states. The economic meaning of the foundation of the German Empire was the stabilization of peace. The German question was settled satisfactorily to the German states and the German people, stabilizing the European equilibrium by creating a strong and essentially peaceful state and replacing the European battlefield of foregoing centuries, under the leadership of Bismarck, who was a European no less than a German statesman.

From 1840–1910, while the population has increased about 100 per cent, the value of the total foreign trade (imports and exports) has increased 1540 per cent. Since the foundation of the empire, while the population has increased by more than one-half, the tonnage of imports has risen above four and one-half times, that of exports almost six times, and the value of imports has increased almost three times and the value of exports nearly four times. In absolute figures, the value of the trade in the three main divisions of trade statistics, in raw materials, in manufactures and in foodstuffs and animals, has risen as well in exports as in imports from 1874 to 1913. But the relative importance of these three headings has changed considerably. Both exports and imports of manufactures have increased relatively, both exports and imports of foodstuffs and animals have decreased relatively. But while from 1874–75 to 1913, exports of manufactures have risen from 39 to 75 per cent of the total exports, imports of manufactures have only risen from 20 per cent to 25 per cent of the total imports; and while exports of foodstuffs and animals have decreased from 27 per cent to 10 per cent of the total exports, imports of foodstuffs and animals have decreased from 33 to 29 per cent of the total imports. Per head of population the export of manufactures amounted to $6.2 in 1872 and to $23.9 in 1913. While in 1874–75 the excess of imports over exports in raw materials was (in billion dollars) 0.42, it was 1.73 in 1912–13. One thousand marks ($250) would buy on the average in 1912–13 69 tons of the imports, but 75 tons of the exports; in 1874–75, it would buy 45 and 48, respectively.

Internal and Foreign Commerce.— Commerce may be internal or foreign. Foreign commerce is of course only a small part of the whole commerce transacted, but a very important one. As a rule every article of commerce in the process of production, distribution and consumption will be the object of commercial transactions several times. Some idea of the extent of the internal commerce will be gathered from the figures of the exports and imports, of the agricultural and industrial production, of the traffic on railroads and waterways and on the banking transactions (of articles under these headings). To give a correct interpretation to these figures it must be kept in mind that production and especially distribution are more decentralized in Germany than in the United States and a larger part of the local production is consumed locally and that commerce is largely dependent on the density of population; the quantity of production being increased with the increase of population but generally not in the same but in a smaller ratio.

To Germany foreign commerce is of vital importance because being very limited generally in the productive power of her soil she is completely deficient in products of the subtropical and the tropical zone and very restricted in the products of the warm temperate zone.

Principal Articles of Export and Import.— In weight the imports of 1913 amounted to 74,600,000 metric tons, the exports to 75,400,000 metric tons, the value of the imports being $2,700,000,000 and that of the exports $2,500,000,000. In the following table the main groups of the imports and exports are given according to the official German statistics.

VALUE OF GERMAN IMPORTS AND EXPORTS IN 1913.

CLASSES	Imports	Per cent	Exports	Per cent
Raw materials....	$1,251,000,000	47	$379,000,000	15
Manufactures for further mfture..	310,000,000	11	285,000,000	11
Manufactures for consumption...	370,000,000	14	1,599,000,000	64
Foodstuffs.......	690,000,000	25	259,000,000	10
Animals.........	72,000,000	3	2,000,000	....
Total.......	$2,693,000,000	100	$2,524,000,000	100

The list below shows only those kinds of merchandise where there is a substantial surplus (of at least $25,000,000) on the import or on the export side and only the excess of imports over exports or of exports over imports. The exports of industrial metals other than copper and iron, viz., lead, zinc and tin, being so large as not to leave a considerable excess in the imports the figures have been dropped. Because only differences are given the tables comprise a much larger part of Germany's foreign commerce than the figures themselves seem to indicate. Thus a true picture will be given as to what Germany really needs and what she is really able to sell.

The textile industries are the most dependent on foreign production, the net imports of cotton, wool and raw silk accounting for $288,000,000. Of grain, including bran and rice, imports exceeded exports to the extent of $222,000,000. Imported barley (to the amount of 3,100,000 metric tons) constituted 50 per cent, imported wheat (to the net amount of 2,000,000 metric tons) 35 per cent of the total amount available for consumption (that is, deducting the amount of the home production necessary for seed), while in rye there was a not inconsiderable (500,000 metric tons) and in oats a smaller surplus (200,000 metric tons) of exports. Rice and maize are not produced in Germany. The net imports in fats and oils and in materials for fat and oil production of animal and vegetable origin amounted to $204,000,000, which figure is not far behind the amount of net imports in breadstuffs. Coffee, cacao and tea together accounted for $69,000,000 in the net imports. The net imports of cotton amounted to 486,000 metric tons, about 16 pounds per head of population, those of wool to 183,000 metric tons, about six pounds per head of population (besides a large home production), and of coffee to 164,000 metric tons, about 5.4 pounds per head of population. In mineral products the net imports constituted in 1912 24 per cent of the total consumption of iron ores (10,000,000 metric tons out of 42,000,000), 82 per cent of copper (196,000 metric tons out of 241,000), 19 per cent of lead (45,000 metric tons out of 232,000), while the net exports of coal (coke and lignite) amounted to 5 per cent of the total production (14,000,000 metric tons out of 256,000,000), and of zinc to 18 per cent of the total production (48,000 metric tons out of 269,000). A large amount of materials imported is exported in a manufactured form, especially in the leather and silk industries. With manufactures even if classified under the same statistical item, imported goods are generally not the same as exported ones. Especially in the textile trade imports of manufactures are large, those of cotton yarn amounting to $29,000,000, of woolen yarn to $27,000,000, of cotton goods to $18,000,000, and of woolen goods to $11,000,000. The only other large item in the imports of manufactures are machines to the value of $20,000,000, of these mowers amounted to $5,600,000, and of metal-working machines to $2,200,000. Books and maps are exported to the value of $18,600,000, pianos and organs to the value of $13,900,000.

EXPORTS AND IMPORTS OF IMPORTANT MERCHANDISE IN 1913 — BALANCE OF EXPORTS AND IMPORTS.

Balances over $25,000,000 only.

ARTICLES	Imports	Exports
Raw materials and foodstuffs of animal origin:		
Wool....................	$106,000,000	....
Hides....................	94,000,000	....
Animals for meat.........	59,000,000	....
Animal fats and oils (except butter)...........	52,000,000	....
Eggs....................	48,000,000	....
Raw silk................	38,000,000	....
Fishes and clams..........	31,000,000	....
Butter..................	30,000,000	....
Horses..................	28,000,000	....
Raw materials and foodstuffs of vegetable origin:		
Cotton..................	144,000,000	....
Materials for oil-production..	122,000,000	....
Barley..................	98,000,000	....
Wood...................	89,000,000	....
Wheat..................	71,000,000	....
Sugar..................	....	$66,000,000
Coffee..................	55,000,000	....
Bran...................	38,000,000	....
Oil cakes...............	20,000,000	....
Maize..................	25,000,000	....
Raw materials of mineral origin:		
Coal (coke).............	....	108,000,000
Copper.................	81,000,000	....
Iron ores...............	55,000,000	....
Other ores..............	53,000,000	....
Mineral oils.............	43,000,000	....
Chilean nitrates..........	41,000,000	....
Potash, sodium...........	....	31,000,000
Manufactures:		
Iron merchandise.........	....	283,000,000
Machines................	....	170,000,000
Cotton goods.............	....	93,000,000
Electrical goods..........	....	67,000,000
Woolen goods............	....	57,000,000
Dyes of aniline, alizarine, indigo..................	....	52,000,000
Leather and leather goods....	....	52,000,000
Paper..................	....	49,000,000
Silken goods.............	....	39,000,000
Clothes.................	....	28,000,000
Toys...................	....	26,000,000

Geographic and Political Distribution of Germany's Foreign Commerce.— German statistics are not very reliable as to countries of origin and destination since a very considerable amount of German foreign trade is carried on via Great Britain, Holland, and Belgium and a smaller amount via France (Marseilles), Italy (Genoa) and Austria (Trieste). But there is no doubt that the oversea commerce has been increasing faster than the continental commerce and the commerce with countries of economically colonial character considerably faster than with the old-settled countries of Western and Southern Europe. But even now the European commerce of Germany is by far the most important especially in exports comprising more than one-half of all imports and three-quarters of all exports.

the empire lasted until 1879. It placed Germany in a very dangerous position, both for her agricultural production (in the free competition with American agriculture), and in her industrial production (in free competition with the technically highly developed British industries). The fundamental change for a protective policy was marked by the Tariff Law of 1879. The free trade policy of 1892 aimed at a Continental European economic union, with Germany as the leading industrial country, thus procuring profitable labor for her increasing population. That policy, however, failed in the main aim owing to the national jealousies among the European nations, but led to the

MOST IMPORTANT COUNTRIES IN IMPORTS AND EXPORTS, 1913.

(Only figures above $50,000,000 are given.)

Imports to Germany from		Exports from Germany to	
United States	$428,000,000	Great Britain	$359,000,000
Russia	356,000,000	Austria-Hungary	276,000,000
Great Britain	219,000,000	Russia	220,000,000
Austria-Hungary	208,000,000	France	197,000,000
France	146,000,000	United States	178,000,000
British India	128,000,000	Holland	173,000,000
Argentina	124,000,000	Belgium	138,000,000
Belgium	86,000,000	Switzerland	134,000,000
Holland	83,000,000	Italy	98,000,000
Italy	79,000,000	Denmark	71,000,000
Australian Confederation	74,000,000	Argentina	66,000,000
Brazil	62,000,000	Sweden	57,000,000
Dutch India	57,000,000	Brazil	50,000,000
Sweden	56,000,000		
Switzerland	53,000,000		
Chile	50,000,000		
Spain	50,000,000		

The problem of international exchange is made very difficult for Germany by the fact that the figures of export and import with the most important countries differ widely and that countries exporting raw materials and foodstuffs most needed by Germany are, generally, not the countries needing most and in adequate quantities the products of German industries. This is especially true of the United States.

The trade of Germany with the Entente Powers of Europe (Great Britain, France, Russia, Italy, Belgium, Rumania, Portugal, Serbia, Montenegro, and their non-European political dependencies) constituted in 1913 almost one-half of the total German foreign trade and more than one-half of the imports alone, amounting to about $1,280,000,000 in the imports and about $1,210,000,000 in the exports. The trade with the British Empire amounted to about $550,000,000 in the imports, or 20 per cent of all imports, and about $470,000,000 in the exports, or 19 per cent of all exports. The trade with Sweden, Norway, Denmark, Switzerland, Holland, Spain and Greece and their non-European political dependencies amounted to $370,000,000 in imports and $540,000,000 in exports, or 17 per cent of the total German trade. The trade with the countries united in the Confederation of the Central Powers (Austria-Hungary, Turkey, Bulgaria) was, with a total of $560,000,000 — $240,000,000 in imports and $320,000,000 in exports — only about 10 per cent of the total German trade and only about one-half of the total German trade with Pan-America which amounted to $1,100,000,000, of which $730,000,000 was on the import side and $370,000,000 on the export side.

Commercial Policy.— The free trade policy already inaugurated before the foundation of

establishment of a system of commercial treaties binding together the European states for periods of 12 years (the first ending 1904, the second so far as not terminated by the outbreak of the war, 1914–18). The tariff of 1902 (the basis of the tariff treaties of 1904–05) was again highly protective, especially for the agricultural interests, partly as a result of the growing conviction that a large raw production in agriculture and in mining was necessary to preserve the political independence of the nation. But it was only during the last few years before the war that the question of raising all the necessary foodstuffs in Germany proper was discussed.

Customs Duties.—The gross amount of customs duties collected in 1913 was $181,000,000. There is in Germany a system of export certificates on some dutiable products like rye which allow for free imports of a corresponding amount of dutiable foodstuffs and which are used for the payments of import duties. The amount of duties paid by those export certificates (in 1913 about $40,000,000) is not included in the figures above. By far the greater part of the customs duties ($138,500,000) is derived from foodstuffs. The German consumer had to pay in the price of the foodstuffs imported on the average one-fifth more, and of grain particularly one-third more than the price would have been if free imports were granted. The German farmer, especially the larger one, enjoys the benefit from the higher price level being stabilized in this position by the system of export certificates if Germany's own production should exceed the amount that she wants for her own consumption. By agreement between the government and the parties the receipts from the raising of the grain duties in the Tariff Law of 1902 had to be reserved for the establishment of a national insurance for widows and orphans (introduced by the Insurance Law of 1911). That clearly indicates the close connection between the protective and the social policy of the German Empire.

Germany's Commerce with the United States.— In 1913 the United States occupied the first place in imports to, but only the fifth place in exports from, Germany, according to German statistics, and Germany held the second place in imports to, and the third place in exports from, the United States, according to American statistics. Of the total exports from the United States 14.5 per cent went to Germany, of the total imports 10 per cent came from Germany. Of the total imports into Germany 16 per cent came from the United States, while of the total exports only 7 per cent went to the United States. The trade balance between the United States and Germany is overwhelmingly in favor of the United States. Ger- the last 25 years. In 1890 the trade balance was slightly in favor of Germany. Since 1890 the exports from the United States to Germany have increased more than 300 per cent, while the exports from Germany to the United States did not increase 100 per cent. That development is due to the growing industrialization of Germany with growing needs of imports in raw materials and foodstuffs, cotton, fats, wheat, copper, and to the growing industrialization of the United States, backed by a strong protective tariff policy which tends to exclude foreign manufactures from the American market. While Germany needs urgently some of the products in which the United States abound, there is no corresponding demand in the United States for goods produced in Germany.

Concerning the articles of import from the United States to Germany, the concentration on a few articles extensively produced in the

DEVELOPMENT OF GERMAN TRADE WITH THE UNITED STATES.

(According to both the American and German statistics.)

	German imports from the United States		German exports to the United States	
YEAR	German	American	German	American
1890	$102,000,000	$85,000,000	$106,000,000	$90,000,000
1900	255,000,000	187,000,000	110,000,000	97,000,000
1913	428,000,000	332,000,000	178,000,000	189,000,000

SOME OF THE LEADING AMERICAN EXPORTS TO GERMANY.

	1890	1900	1913
Cotton	$35,000,000	$64,700,000	$115,400,000
Copper	100,000	25,300,000	73,500,000
Wheat	2,200,000	15,100,000	41,200,000
Lard, margarine	11,600,000	21,000,000	33,300,000
Mineral oils	15,900,000	18,900,000	20,600,000
Hides, largely for furs	1,900,000	1,500,000	19,900,000
Grains, other than wheat	11,600,000	29,000,000	18,200,000
Oil cakes, cotton oil	2,000,000	9,100,000	9,700,000
Resin, turpentine oil	2,000,000	6,600,000	9,000,000
Fruits, fresh and dried	400,000	3,000,000	8,500,000
Meat, tallow, intestines	2,500,000	9,100,000	4,400,000

SOME OF THE LEADING GERMAN IMPORTS TO THE UNITED STATES.

	1890	1900	1913
Half silken goods	$17,200,000	$6,800,000	$1,500,000
Woolen goods	6,800,000	1,800,000	2,100,000
Cotton hosiery and gloves	8,700,000	6,300,000	5,300,000
Cotton laces	1,700,000	2,500,000	3,200,000
Leather gloves and leather for gloves	5,000,000	5,800,000	5,300,000
Hides for furs and others	1,100,000	3,200,000	12,200,000
Potash, potassium chloride, etc	1,200,000	4,700,000	17,400,000
Porcelain	1,100,000	4,000,000	2,700,000
Toys	2,000,000	3,600,000	8,100,000
Chemical dyes	1,900,000	5,600,000	9,500,000
Tropical products (rubber, oil)	600,000	3,000,000	5,600,000
Books, prints	3,400,000	4,000,000	1,500,000

man statistics show American imports to Germany amounting to $428,000,000 against exports to the United States amounting to $178,000,000. American statistics show American imports into Germany amounting to $332,000,000 against German exports to the United States amounting to $189,000,000. In the figures of the American statistics the freight costs of the German exports to the United States are already included in the prices of the imported goods to America, while the freight costs from the United States remain to be paid for. According to the American statistics that means when the freight costs are already paid or have to be paid by Germany there remains a balance against Germany of $143,000,000. Suppose the German capitalist investments in the United States (about three-quarter billion dollars, mostly railroad bonds) yield a yearly income of $50,000,000, there remains a passive balance of more than $90,000,000. That unfavorable trade balance has been developed gradually during United States has become more and more accentuated; in 1913, cotton, copper, wheat, lard and margarine accounted for almost two-thirds of the total imports. American imports constituted 76 per cent of the total German imports of cotton, 88 per cent of copper, 40 per cent of wheat, 77 per cent of lard, and 54 per cent of mineral oils in 1913. In the same year, the more important items of products of American manufactures imported to Germany were mowers, $4,400,000; machines for the working of metals, $1,400,000; cash-registers, $1,100,000; and typewriters, $1,100,000. Concerning the articles of export from Germany to the United States there is not one item of considerable amount, but most are very small. Considering only those amounting to $1,000,000 or over, the textile industries leading with $21,000,000; next come the products of the German potash mines, with $17,000,000; the leather industries, $17,000,000; the chemical industries, especially dyestuffs, $12,000,000. The table of the leading import goods from Germany in 1890, 1900 and 1913, shows clearly the influence of the American tariff legislation in excluding German and fostering American manufactures. Half silken goods, the dominant article of German export in 1890, has ceased to be of any importance, woolen goods, leather gloves, cotton hosiery, porcelain, all prominent features of the exports of 1890 or 1900, have greatly decreased in importance. No corresponding tendency of excluding American products is observed, all the leading items of American imports to Germany showing large and continual gains. Concerning the imports of products of the slaughter-houses from the United States to Germany, one may remember that the United States has ceased to be a meat-exporting country, while the decrease in exports of other grain except wheat, is largely counterbalanced by the increase in the exports of wheat.

Bibliography.— Barmen, R., 'Deutschlands Stellung im Welthandel und Weltverkehr' (1914); Harms, B., 'Deutschlands Anteil an Welthandel und Weltwirtschaft' (Berlin 1916); Helfferich, K., 'Germany's Economic Progress and National Wealth' (ib. 1915); Zahn, F., 'Deutschlands wirtschaftliche Entwicklung' (ib. 1914).

H. LUFFT.

21. GERMAN INDUSTRIES. The foundation of modern German industrial progress was laid in the first two decades following the Franco-Prussian War, and its cornerstone was the improved processes of iron and steel production. In addition to Germany's original mining districts, there were in the territories acquired from France large deposits of iron ore which at that time were of negligible value, since the purer ores of England and the United States could be produced much more cheaply.

Germany's production of pig iron in 1887 was 4,024,000 tons, as compared with Great Britain's production of 7,681,000 tons and that of the United States of 6,520,000 tons, while the production of steel was 954,600 tons, 2,403,200 tons and 2,604,000 tons, respectively. About that time new metallurgical processes were invented, notably the Thomas-Gilchrist process for the elimination of the phosphorus of iron ore, which not only made available Germany's vast unused deposits of iron ore, but also stimulated agriculture through rendering the phosphorus available for fertilizer.

Within 20 years Germany's pig iron production had increased 400 per cent, while Great Britain's had increased only 30 per cent. Germany's steel production had increased 1,300 per cent, while Great Britain's had increased only 150 per cent. Thus Germany had outstripped England and was within a comparable distance of the United States with its much greater deposits. Meanwhile Germany had been making great strides in technique and organization, and taken in connection with the tremendous impetus of the flood of iron and steel, the whole industrial life of Germany quickened and grew to gigantic proportions. See article GERMANY'S ECONOMIC ORGANIZATION.

While the iron and steel production would have made Germany prosperous under ordinary conditions, it can only be regarded as the fuel in the great engine of German organization, a policy which almost automatically, once adopted, put Germany at the head of the industrial procession. That policy is one of encouragement, supervision, initiative and direct participation by the government in the industrial life of the nation. Other governments are content to see their industries develop of their own accord and to take any action relative to industrial matters only when forced to do so by the pressure of public opinion. The German system is to take the initiative, devise means of stimulating industry, direct, supervise and participate in industrial undertakings, provide systems whereby workers may be properly trained, raw materials procured, invention stimulated, capital obtained, the evils of competition avoided and finally markets for the goods developed. Thus every possible encouragement is offered to industry by the German government.

The basic technical principle of Germany's industries is that of transforming cheap raw materials into highly valuable finished products. Being rich in man power and comparatively poor in raw materials and natural resources, the tendency has been to conserve as far as possible the resources in materials and to use to the best possible advantage the man power available and to increase its skill and multiply its productivity by new inventions and efficient methods of utilization.

In every department of industrial activity the same general principle is followed of utilizing cheap raw materials for the manufacture of highly valuable products.

The political organization upon which German industrial progress is founded was established at the time of the founding of the German Empire at the end of the Franco-Prussian War. It is in a sense paternalistic, but paternalistic in the best sense.

Germany has a highly effective political system, whose policies when determined upon by the Bundesrat are carried into effect forthwith and effectively. When the government adopts a policy of industrial encouragement, it is certain to be carried into effect. Where private activity is insufficient the government enters into the scheme of things directly, which is especially true in the encouragement of scientific and technical schools, and in the maintenance of testing laboratories and of corps of experts who are constantly engaged in perfecting and developing new inventions and industrial processes and who are always ready to assist manufacturers in the solution of their particular problems. Professors of technical universities are making constant contributions of an inventive nature to the general fund of industrial and technical knowledge and are always ready to lend their time and facilities to the cause of industry, while large industrial concerns maintain staffs of experts for the special consideration of their own problems.

The activities of German technique are reflected in the number of technical publications in the German language, which is annually several times the number of publications in all other languages combined. Such a vast volume of technical effort does not fail to make itself felt. It is the driving force back of German prosperity. It is not a force, however, which is permitted to wear itself down. The government constantly keeps in touch with the industrial life of the nation and does not permit its self-improving spirit and initiative to flag. Not only by direct supervision is industry stimulated, but in indirect ways it is even more effectively encouraged. For example, the successful man of business, the notable inventor or technician is honored with positions of political importance and with decorations signalizing his work.

The German business man has opportunities of serving the government to which he may properly aspire as do our great lawyers to the Supreme Court bench, and as a consequence the government service attracts and rewards the brightest minds and gives as well as acquires prestige. Springing from such a source, it will be obvious that the energies of the government directed toward the improvement of industry will be effective and that any lack of individual incentive will be supplemented by governmental initiative.

Not alone in a technical sense is industry encouraged, but financially as well, since it is realized that without suitable provision for capital new industries cannot make headway and old ones will languish. Special banks make it a feature of their business to provide capital on fair terms to new industries and inventions which are seen upon investigation to be worthy of encouragement. Thus any meritorious enterprise is sure of a fair start and does not have to run the gauntlet of unsavory promotions as in some countries. Once started, new industries are protected so that larger concerns cannot drive them out of business, and thus the small business man, on whom the prosperity of the public eventually depends, is protected in his undertakings. In the place of trusts, which are of a predatory nature and seek to ruin competitors with the ultimate object of despoiling the public, German industry is organized as a number of cartels which are encouraged by law and in which even the government participates as a member. In its organization, the cartel approaches that of the price-fixing pool in vogue in the United States before the era of trusts. In the pool, the various competing firms agreed on prices to be charged to the consumer by all the members, and upon volume of output to be allowed to each member. In some cases the earnings were lumped or pooled and later divided on a certain pro rata basis. This made it possible for competing firms to exist and do business at a profit, which would otherwise have cut each other's prices to a point of bankruptcy. It is obvious that business to exist must make a normal profit, but in a state of unregulated competition the richer firms may sell their goods at such low prices that the small firms are ruined.

In Germany the tendency of business men to form into self-protecting groups was recognized as a proper and necessary effort. The individual business men and companies of an industry were permitted to organize themselves into a loose form of organization known as the cartel. In some cases there would be one or more cartels in an industry, and in others but one cartel for a number of industrials. Individual firms may remain outside of cartels if they prefer. The cartel is empowered to fix prices to be charged to the public and to allot the amount of business to be done by each member or the proportion of output to be allowed as compared with the output of the whole cartel. Competition is thus largely confined to quality and economies in production and service rather than price. A living profit is made possible and stability of the market insured. The public is not mulcted since the cartels are under legal supervision and are not allowed to fix prices at unreasonable levels.

The German industrial system is thus very flexible, being adapted to meet in the most favorable manner any and all of the problems which may arise. It preserves individual initiative, promotes proper competition but prevents its destructive manifestations, and is capable of meeting the most formidable rivalry, whether such rivalry exhibits itself at home or abroad. The efficacy of the German industrial system is particularly shown in the foreign field. The government is constantly active in fostering foreign trade and in seeing the German manufacturers and exporters make use of every opportunity which presents itself. Even should the immediate business in hand not promise an inviting profit, the manufacturer is encouraged to occupy the field from motives of patriotism, in the knowledge that once the market is occupied by German goods other goods will be shut out and in time the trade will prove profitable. Suitable banking and financial arrangements are made so that the customs of foreign business may be observed and thus every effort is made to permanently establish German trade in every quarter of the globe. It is not surprising, therefore, that German industry, with such far-reaching plans of organization in operation, should have made enormous strides.

The figures of the increase of iron and steel production previously referred to are an index of Germany's industrial growth.

PIG IRON PRODUCTION (in tons).

COUNTRIES	1887	1911	Increase per cent
Germany	4,024,000	15,574,000	387
United Kingdom	7,681,000	10,033,000	30
France	1,568,000	4,411,000	281.3
United States	6,520,000	24,028,000	368.5

It will be seen that the percentage of increase is greater for Germany than even for the United States.

STEEL PRODUCTION (in tons).

COUNTRIES	1886	1910	Increase per cent
Germany	954,600	*13,698,600	1335
United Kingdom	2,403,200	6,106,800	154.1
France	427,600	3,390,300	692.9
United States	2,604,400	26,512,400	910.3

The proportionate increase of Germany's steel output is vastly greater than that of any other country and has reached one-half of that of the United States, with its immeasurably greater deposits.

Of known supplies of coal, it is calculated that Germany's coal will last over 1,000 years; that of France 500 years and that of the United Kingdom only 300 years. Of known iron deposits, the calculated amounts are: Germany, 3,878,000,000 tons; France, 3,300,000,000 tons; United Kingdom, 1,300,000,000 tons and the United States 9,855,000,000 tons.† Germany's share of the European supply is 32.3 per cent

* In the year 1912 Germany's steel production was 15,019,300 tons.

† The restoration of Alsace and Lorraine to France materially alters the relative positions of France and Germany in regard to iron deposits.

and of the world's supply 17.3 per cent. Her pig iron and steel output is only slightly less than one-fourth of the world's total output.

The increase in production in all countries shows the great strides of modern industry all over the world. The present figures show an activity and volume of business that makes the world of a generation ago seem poverty-stricken by comparison.

In the production of coal and lignite Germany has made progress almost as great as in steel and iron. The comparative figures are as follows:

Coal and Lignite Production (in tons).

COUNTRIES	1885	1910	Increase per cent
Germany	73,675,000	222,375,000	201.8
United Kingdom	161,909,000	268,677,000	65.9
France	19,511,000	38,350,000	96.6
United States	100,843,000	455,042,000	351.2

Coal and Lignite Consumption (tons per capita).

COUNTRIES	1885	1910	Increase per cent
Germany	1.50	3.25	116.7
United Kingdom	3.63	4.07	12.1
France	0.79	1.41	78.5
United States	1.76	4.78	171.6

The great increase in the production of coal is an index of the growth of Germany's industries both actually and in proportion to her population; the increase per capita is a demonstration of the intensification of her industrial activities.

The total value of Germany's mined coal in 1887 was 351,300,000 marks while in 1911 it was 1,756,100,000 marks, an increase of 400 per cent. The United States, which was considerably behind Britain, is now far in the lead while Germany has almost equaled Britain and now produces one-fifth of the world's total output of coal.

In coke production Germany has substantially passed Great Britain.

Coke Production (in tons).

COUNTRIES	1905	1910	Increase per cent
Germany	16,491,000	23,600,000	43.1
United Kingdom	17,732,000	19,642,200	10.8
France	2,268,000	2,688,000	18.5
United States	29,240,000	37,838,000	29.4

Germany thus produces one-quarter of the world's coke and is increasing her production at a far more rapid rate than are the other countries. In coke by-products the increase is far more rapid and reflects the important development of Germany's chemical industries.

Coke By-products, Production in Dortmund District (in tons).

BY-PRODUCT	1896	1911	Increase
Sulphate of ammonia	20,975	244,567	1:11.7 (Eleven fold)
Tar	28,341	550,300	1:19.4
Benzol	215	53,941	1:250.9

In addition to her supplies of tar used in chemical industries Germany imports large quantities of tar from the United States which serves to conserve her supplies of raw material. Her gas industry in 1910 consumed coal to the value of 120,000,000 marks ($30,000,000), producing 2,500,000,000 cubic metres of gas (as compared with 325,000,000 in 1877), having a value of 375,000,000 marks ($93,750,000), with by-products having a value of 83,300,000 marks ($20,825,000).

In addition to iron, steel, coal and coke, Germany has other highly important mining industries which have made immense advances in the past generation.

Mining Output (production value in marks).

PRODUCT	1871	1910	Increase
Coal and lignite	244,600,000	1,705,200,000	1:7 (Seven-fold)
Iron ores	30,800,000	106,800,000	1:3.5
Potash and other salts	4,500,000	97,800,000	1:21.7
Zinc, lead and copper ores	25,700,000	82,700,000	1:3.2
Other mining products	8,600,000	16,000,000	1:1.9
Total	314,200,000	2,008,500,000	1:6.4

The increase in mining output thus, of more than sixfold, is due very considerably to the numerous new chemical and technical processes which have made it possible to recover ore values that would otherwise have remained unobtainable. In 25 years the total value of the direct products of German mining have increased from 700,000,000 to 2,000,000,000 marks and this vast augmentation of wealth has transformed Germany from one of the poorest to one of the richest of countries.

In the consumption of copper Germany has a long lead over Britain and compares favorably with the United States and is growing much more rapidly than either.

Copper Consumption (in tons).

COUNTRIES	1901	1911	Increase per cent
Germany	84,800	225,800	166.3
United Kingdom	105,200	159,400	51.5
Rest of Europe	102,100	221,100	116.6
United States	192,300	321,900	67.4
Total	494,200	959,400	94.1

Germany is thus using practically one-quarter of the world's copper output.

In the consumption of cotton Germany occupies third place.

Cotton Consumption.

COUNTRIES	1910–1911 (bales)	Cotton spindles, 1912
Germany	1,685,192	10,598,752
United Kingdom	3,384,480	55,164,794
France	945,815	7,400,000
United States	4,696,000	29,522,597

It will be seen that the consumption of cotton as compared with the number of spindles is much larger in the United States and Germany than in Britain. This does not mean that the consumption per spindle is necessarily greater, but rather that more cotton is used for purposes such as the manufacture of explosives than for weaving. The industrial use of explosives has greatly increased in recent years, especially in the United States, where less than 1 per cent of the output of explosive factories is devoted to the military purposes of the national government.

The superiority of Germany in brewing is rather in the number of breweries than in the volume of the brew.

BREWING (in 1911).

COUNTRIES	Production in hectalitres	Number of breweries
Germany	65,089,000	12,009
United Kingdom	58,813,000	4,226
France	17,942,000	3,203
Austria-Hungary	25,571,000	1,240

The German output of manufactured tobacco has not greatly increased as regards cigars, but cigarette manufacture has increased in a very marked manner.

TOBACCO MANUFACTURE.

PRODUCT	1875	1903	1911
Cigarettes	152,000,000	3,200,000,000	9,382,000,000
Cigars	5,234,000,000	7,384,000,000	8,000,000,000 (estimated)

The great strides of German technical progress is seen in a comparison of the number of persons employed in the various industries, with the increases in output previously given. From the following table it will be seen that while the number of persons employed has increased, the increase has been very much smaller proportionally than the increase of output.

PERSONS EMPLOYED IN VARIOUS INDUSTRIES.

INDUSTRIES	1882	1895	1907	Percentage of increase, 1882–1907
Mining, smelting and saltworks (also wire drawing for 1882)	430,134	536,289	879,600	104.5
Stone and earths	349,196	558,286	747,057	111.1
Metal working	459,713	639,755	905,868	97.1
Machinery	356,089	582,672	1,171,783	229.1
Chemicals	71,777	115,231	167,670	133.6
Illuminating materials, fats, oils, soaps, etc	42,705	57,909	95,957	124.7
Textiles	910,089	993,257	1,094,955	20.3
Paper	100,156	152,909	225,046	124.7
Leather	121,532	160,343	206,313	68.8
Wood and woodworking	469,695	598,496	736,424	56.8
Foods, beverages, etc	743,881	1,021,490	1,260,580	69.5
Clothing trade and cleaning	1,259,791	1,390,604	1,562,382	24.0
Building trade	533,511	1,045,516	1,576,804	195.6
Printing, art reproduction, etc	85,394	147,746	243,262	184.9

Another valuable index of the progress of German industry is seen in the increase in the use of power for industrial purposes. In Prussia's industries the capacity of steam engines amounted in 1882 to 1,222,000 horse power, in 1895 to 2,358,000 horse power and in 1907 to 5,190,000 horse power. During this period of 25 years, therefore, the capacity increased more than fourfold, and in the 12 years from 1895 to 1907 it was more than doubled. In the whole German Empire, for which comparative figures are available only since 1895, the development was similar. In the year 1907 the census showed 124,000 steam engines with a capacity of 7,587,000 maximum horse power, or 5,185,000 effective horse power. What these figures mean becomes clearer when mechanical and human capacity for work is compared. The effective capacity of one mechanical horse power is about the physical labor equivalent of 10 men. Upon this basis the actual work done by German steam engines in the year 1907 was equivalent to the work done by 52,000,000 men, and the increase of actually effective steam horse power from 1895 to 1907 was equivalent to an increase of the working population by about 28,000,000 men.

These figures should be placed in juxtaposition with those of the working population of the empire, which showed 18,900,000 persons for 1895 and 24,600,000 for 1908. In the year 1895 there was, accordingly, for each person engaged in labor, not much more than one equivalent of his labor represented by steam power. But whereas the laboring population increased from 1895 to 1907 by 5,700,000 persons, the steam engines of Germany under-

MECHANICAL POWER IN VARIOUS INDUSTRIES.

INDUSTRIES	Steam power (in horse power)			Electrical power 1907 (in kilowatts)
	1895	1907	Percentage increase, 1895–1907	
Mining, smelting and salt works (also wire drawing for 1882)	995,069	332,968	134.5	422,782,000
Stone and earths	197,796	503,682	154.7	88,570,000
Metal working	142,141	443,224	211.8	128,909,000
Machinery	184,821	1,215,512	557.7	225,026,000
Chemicals	83,587	192,906	118.9	42,288,000
Illuminating materials, fats, oils, soaps, etc	29,942	77,265	158.1	13,368,000
Textiles	515,583	886,373	71.7	75,126,000
Paper	201,422	412,908	104.9	54,966,000
Leather	32,377	85,304	163.5	19,302,000
Wood and woodworking	203,235	346,024	70.3	56,325,000
Foods, beverages, etc	686,263	1,185,819	72.8	152,763,000
Clothing trade and cleaning	19,235	54,852	185.2	18,999,000
Building trade	46,274	189,117	308.7	21,497,000
Printing, art reproduction, etc	18,793	35,974	91.4	40,950,000

went an increase of 2,800,000 horse power; hence the steam power in 1907 represented more than two equivalents of human labor for each person employed in gainful occupations. In reality the increase of mechanical labor power was even considerably greater than finds expression in the above figures, for whereas steam was, along with water power, which was relatively little developed, almost the exclusive source of power for motor purposes till into the last quarter of the 19th century, the development of the electrical industry and the invention and improvement of explosive motors has, during the 25 years under consideration, raised up a new and rapidly developing competitor of steam power.

The preceding detailed table shows the relative use of power among different industries. In addition to steam power, there is given a column covering the use of electrical power, and this substantially augments the total. No figures showing the increase of electrical power are given, as electrical power only began to be used to any appreciable extent about the middle of the last decade of the 19th century.

A summary of the operations of individual corporations in Germany for the year 1911 shows their prosperous condition. The total reserve fund amounted to 23 per cent of the outstanding capital stock and an average dividend of 8.1 per cent was paid. Since German corporations are organized on a sound stock basis, the figures are a real index of conditions.

Corporations, 1911.— Capital and Profits.

Industries	Number of companies	Million marks: Paid up share capital	Reserve funds	Debentures	Net profits	Dividends per cent
Mining	257	2,369.3	512.3	702.2	291.4	9.14
Quarries, brickworks, etc	348	448.9	68.0	105.2	44.1	6.38
Metal working	160	278.6	43.2	48.7	34.8	7.64
Machinery industry	534	1,789.5	351.0	694.9	218.3	8.70
Chemical industry	302	637.8	180.7	168.5	126.9	13.95
Textile industry	352	637.7	165.1	155.8	73.8	7.44
Paper	99	178.6	41.5	65.3	19.7	8.16
Leather and rubber	58	122.9	40.3	36.5	20.6	10.59
Wood	62	73.5	9.3	15.7	8.2	7.83
Food, etc	812	1,027.9	207.6	246.3	114.9	7.47
Clothing	12	20.3	2.9	2.2	3.0	11.45
Cleaning	3	0.3	0.02	0.07	0.01	2.5
Building trade	43	80.6	11.5	7.6	16.7	12.13
Printing, newspaper trade, etc	114	83.0	11.7	7.3	9.3	6.96
Commerce	268	494.3	48.6	146.2	41.7	4.88
Banking	415	3,815.4	1,042.7	127.3	397.1	7.91
Insurance	130	155.2	238.0	0.3	69.2	23.14
Transport	479	1,543.5	226.1	657.8	104.1	4.98
Miscellaneous	232	470.2	54.1	159.7	41.7	5.81
Total (statistically dealt with)	4,680	14,228.0	3,255.0	3,347.0	1,636.0	8.09

The figures in the various tables given are only up to 1911, but are the latest obtainable. They were compiled from original governmental sources, but as such figures are available only in reports from various departments, often not in published form, the assembling of the comparative figures demands considerable work and time and the interruption of the war makes later data unavailable. In iron and steel and certain other lines production was greatly augmented by the war so that the conclusion of the conflict saw largely increased facilities in many lines of industry.

The rapid development of German industry during the last generation has been accomplished for the most part by the larger establishments. The smaller establishments, though they have not decreased actually, have gained little ground while the large establishments have grown rapidly both in number and size.

Hand industries, the operations of which are carried on by individual workers or small groups of workers in their homes, have existed in Germany for many centuries and do not readily yield to the encroachments of the larger units, but they have not been gaining proportionately. The factory has absorbed all the increase and in some cases has made inroads on the home industries. More recently, the improved facilities for the distribution of electrical power have given the home industries a new advantage as manufacturers and electric central station concerns find it profitable to install small, electrically operated machinery in the workers' homes, which enables the services of certain of the members of the family to be utilized, keeping the machines constantly at work in specialized operations, producing parts, which are assembled in the factory into the finished product.

This is a modern phase of home industry quite unlike that of olden times in which the home workers were highly skilled and produced finished products which could not be matched by the factories. Home industry varies widely according to location. In the cities such products as clothing, men's furnishings, women's apparel, leather goods, jewelry and ornaments, linen and wash articles are favored, while in rural, woodland and mountainous districts, as in middle and southwest Germany, household articles are produced such as wooden articles, knit goods, brushes, toys, embroideries, clocks, violins and the like. Manufactured farm, meat and dairy products are also largely produced in the rural districts rather than in packing establishments. The drift to the cities has been affected by and has affected the industrial situation. The invention of labor-saving agricultural machinery and processes of cultivation have increased the productivity of the farms at a saving of labor, though the increased demand for food by reason of the growing population has somewhat offset the freeing of agricultural laborers for other pursuits by reason of such improvements.

The industrial censuses of 1882, 1895 and 1907 show the extent of the drift to the cities. The total number of persons employed in agriculture, industry, trade and transportation was as follows:

Total Number of Persons Employed.

1882.. 16,203,000 persons or 35.4% of the whole population
1895.. 18,912,400 persons or 36.4% of the whole population
1907.. 24,617,200 persons or 39.7% of the whole population

This indicates an increase in the proportion of persons employed in these activities, which may be accounted for by the fact that the size of families has decreased while the population has increased, there being fewer dependent members of the family in the later years than in the earlier years, compared with the whole population.

The decrease in the proportion of dependents of those engaged in agricultural pursuits while the proportion of dependents in industry and trade, however, as shown by the following table, is due more to the fact that Germany has enjoyed a considerable immigration of adult farm laborers and to the fact that much of the agricultural labor is performed by a floating class of adults, workers who drift into other occupations during dull seasons of the agricultural year. The following table shows the distribution of workers among the main branches of industry.

ural growth of the population into a source of increasing wealth. The prosperity and activity of German industry has caused the earnings of workers to be increased materially until in actual amounts, as well as in purchasing power, the German industrial worker is the best paid worker of his class in Europe.

Germany's great progress brings more and more completely into effect the signal characteristic of modern industry, that of the division of labor and the association of labor. Division of labor is the giving to each worker of a single form of work in which he becomes highly proficient while association of labor is the bringing together of workers, each performing his own special task, into a group which produces a finished product in the most efficient manner through the economies effected by the division of the several operations and the combination of their results. The tendency of the association of labor is toward larger and larger groups. Thus certain factories own their own mines and transportation facilities so that from the time the ore is taken from the earth until the finished mechanism or product into which it is transformed by the successive operations to which it is subjected is delivered to the purchaser, the whole procedure is carried out by the one concern.

It appears, therefore, that of all persons engaged in gainful employments in 1882, 59 per cent were employed in small concerns, 18.5 per cent were employed in medium and 22.5 per cent in large concerns. In 1907, on the other hand, only 37.3 per cent were employed in small concerns, 25.7 per cent in the medium concerns and 37 per cent in the large concerns. Whereas, therefore, more than two and one-half times

Distribution of Workers.

Callings by groups	Years	Persons employed	Persons employed, including dependents	In percentages of whole population: Persons employed	In percentages of whole population: Employed and dependents
Agriculture and Forestry	1882	8,236,500	19,225,500	18.0	42.0
	1895	8,292,700	18,501,300	15.9	35.6
	1907	9,883,300	17,681,200	15.9	28.5
Industry	1882	6,396,500	16,058,100	14.0	35.1
	1895	8,281,200	20,253,200	15.9	38.9
	1907	11,256,300	26,386,500	18.2	42.5
Trade and Transportation	1882	1,570,300	4,531,100	3.4	9.9
	1895	2,338,500	5,966,900	4.5	11.5
	1907	3,477,600	8,278,200	5.6	13.3

In connection with this readjustment the displacement as between the population of country and city is to be noted. In 1885, 8,600,000 persons or 18.4 per cent of the whole population lived in cities of more than 20,000 inhabitants, while in 1910 22,400,000 persons or 34.5 per cent of the whole population lived in such cities. The number of inhabitants in the large cities of more than 100,000 population, of which there were 21 in 1885 and 48 in 1910, amounted in 1885 to 4,400,000 persons or 9.4 per cent of the whole population and in 1910 to 13,800,000 persons or 21.1 per cent of the whole population. While there are certain drawbacks to this shifting of the population, it has been the factor which has made it possible to give labor and sustenance on German soil to the vastly increased population and to transform the nat-

as many persons were employed in small concerns in 1882 as there were in large ones, the two classes had almost reached an exact equality by 1907. From 1882 to 1907 the number of persons engaged in small undertakings increased not quite one-fourth, whereas the number in the great concerns increased more than threefold, and those in the very largest concerns four and one-half fold.

In individual groups of callings this development was still more pronounced than in the general average; as, for example, in metal working, in the machinery, instrument and apparatus industries, in the industries of wood and woodworking and in the building trades. In metal working there were 288,000 persons employed in 1882 in small concerns, and only 85,000 in large ones. In the machinery industry the ratio in 1882 was 123,000 to 166,000 persons, but in 1907 it was 136,000 to 788,000. In the building trades it was 245,000 to 95,000 in 1882, but 315,000 to 633,000 in 1907. In mining and smelting, in which small and medium concerns were quite insignificant already in 1882, not less than 832,000 out of a grand total of 861,000 persons employed in 1907 were in the large concerns. The development of the second form of association of labor, namely, that of bringing together various processes of production into a centralized undertaking — did not lag behind the shifting in the sizes of undertakings just described. The production of raw and secondary materials was united, on a large scale, with manufacturing concerns; businesses producing semi-manufactured goods found it to their advantage, in an increasing degree, to take in hand the production of finished goods; producing establishments annexed transportation undertakings, so far as these were not monopolized. This development was seen not only in industry, but also in agriculture, where dairies, distilleries, breweries, sugar factories and the like have become to an increasing degree a part of the regular appurtenances of the great agricultural establishments.

The development of business enterprises into larger and larger units is shown by the following table:

NUMBER OF ESTABLISHMENTS AND PERSONS EMPLOYED.

SIZE	1882		1895		1907*	
	Establishments	Persons employed	Establishments	Persons employed	Establishments	Persons employed
Small, 1–5 employees	2,882,768	4,335,822	2,934,723	4,770,669	3,124,198	5,353,576
Medium, 6–50 employees	112,715	1,391,720	191,301	2,454,333	267,410	3,644,415
Large, 51–1,000	9,974	1,613,247	18,953	3,044,267	32,007	5,350,025
1,000 and more employees	127	213,160	255	448,731	506	954,645
Totals	3,005,457	7,340,789	3,144,977	10,269,269	3,423,615	14,348,016

* Not including music, theatres and public amusements.

To what degree the organization of German public economy has been perfected during the past 25 years, to what degree it has increased the productive capacity of German economic labor and contributed toward enhancing the wealth of the public, is strikingly illustrated by the statistics of German exports and imports.

In the year 1912 foreign trade reached a total of $4,900,000,000 of which $2,675,000,000 was imports and $2,245,000,000 was exports. Of the imports, $2,275,000,000 was in food products, animals, industrial raw materials and semi-manufactured products, and only $400,000,000 in finished goods. On the other hand, not less than $1,450,000,000 of the total value of $2,245,000,000 of exports was in finished goods.

Germany accordingly exchanges to a very great extent the products of its industrial labor for the primary products of field, forest and mines, which owing to the disproportion of its population to its area and the climatic restrictions upon its agricultural producing capacity, it can produce in only insufficient quantities or not at all.

The internal division of labor finding outlet in the foreign trade has therefore contributed in its development, not only toward giving the German people more abundant and more varied means for satisfying their wants, but has really created the conditions that made it possible for the great increase of the population during recent decades to find the means of subsistence on German soil.

Bibliography.— Helfferich, Dr. Karl, 'Germany's Economic Progress and National Wealth' (Berlin 1914); Koester, Frank, 'The Price of Inefficiency' (New York 1913); and 'Secrets of German Progress' (ib. 1915); Dresdner Bank, 'Germany's Economic Forces' (Berlin 1913); 'Deutschland als Weltmacht' (ib. 1911).

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22. GERMAN AGRICULTURE. In the middle of the 19th century Germany was still predominantly an agricultural country. At that time 65 per cent of her total population were engaged in occupations relating to the soil. By 1882 only 42 per cent were so employed, and in 1907 (the last official census that dealt with vocation) this figure had further decreased to 31 per cent. Germany was no longer able to feed her people on products of her own soil; she had become an importer of foodstuffs on a large scale, and fully one-third of her total population was forced to depend upon these imports in order to live. The main sources whence Germany had to draw for victuals from abroad were Russia, the United States, Hungary, Rumania and Argentina, and the chief staples obtained from these countries were rye, wheat, barley, oats, meats of every kind, lard, bacon, cattle feed, etc., besides which fish, potatoes, condensed milk, butter, cheese, etc., were also bought from Switzerland, Holland, Norway, Denmark and Sweden in huge quantities. However, the Great War wrought considerable changes in all this. By obtaining their nitrogen in unlimited quantities from the air, by chemical processes, instead of relying on the guano of Chile to manure their fields with; by cultivating even portions of the barren regions formerly used as mere wild pasture lands, such as the vast Lünebürg heath and the moorlands of East Frisia, the hitherto sterile tracts of the basaltic Eifel region, the meagre soils of East Prussia, the rocky slopes of the Black Forest, of "Saxon Switzerland" and the lower ranges of the Erzgebirge and Fichtelgebirge between Saxony and Bavaria, and by draining and utilizing some of the bogs of the North Sea coasts and clearing some forest lands, the total yield of the empire has been somewhat increased since 1914, despite scarcity of labor and the otherwise unfavorable conditions prevailing in war times. But, of course, these achievements are purely experimental, and economically were only made possible by the enormous advance in food values due to the blockade. They will disappear with peace restored. Up to 1914 of the total area of 208,830 square miles, some 78 per cent, or about 105,000,000 acres, in Germany was farmland, and some 60 per cent of this was under cultivation, the remainder being meadows, some pastures, orchards and vegetable gardens. About 25 per cent of the total area of Germany is in forest and but 7 per cent wasteland, city buildings, etc. The best farming lands are in the warm, well-sheltered Rhine Valley, with its rich alluvial soil, where vegetation is usually a fortnight ahead of the rest of Germany and where the vine flourishes in special excellence. Many of the hill slopes throughout the highland of Germany are terraced and cultivated, but the mountains are forest-clad, and cultivation is chiefly confined to the plains and valleys. Soils differ greatly, of course; but generally speaking, that in the western portion of Germany is preferable in fertility to that of the low plains of the north and east, the latter being more sandy. Even before the war the available land was tilled with great care and intelligence, not only in the fertile valleys of the south and west, but also on the less productive lands of the north and east. Germany is a country where agriculture has become almost a perfect science. In her agricultural colleges and universities, in her technical schools teaching a thorough knowledge of soils and tillage, of crop conditions, of fertilization, of cattle raising, fruit growing and gardening, everything that tends to rational agriculture and fitting means to the end is inculcated in a thorough manner, and many of her most expert scientists have devoted themselves since the days of Liebig and Pettenkofer to original research work in this line, experimenting with seeds and soils and temperatures and moistures, much in the same way in which similar work is being done in the United States in agricultural experiment stations under State supervision or of that of the American Department of Agriculture. Germany thus grows every variety of grain and fruit produced within the temperate zone. Of cereals, wheat, rye, barley, oats, are raised in all sections of the country; spelt (about one-half million tons per annum) and maize or corn (popularly called in Germany «Turkish wheat») ripen only in the south; much buckwheat grows in the north, and potatoes, lentils, beans and peas also thrive better in the northern half; while flax and hemp, rape, poppy, caraway seed are raised mostly in the central hilly regions. But hops is produced as far north as the province of Posen, though the best by far comes from Bavaria, Baden and Württemberg. The beet root, which furnishes sugar for inland consumption and export, flourishes mostly in Saxony, Silesia, Hanover, Anhalt and Brunswick. It was in the Prussian province of Saxony, in fact in the vicinity of Magdeburg, Erfurt and Merseburg, that the sugar industry first arose, due to the special adaptability of the soil. The system in vogue in Germany for many years, the so-called «three-year rotation,» allowing the land to lie fallow every third year, has been done away with long ago, and the regular alternation of crops is supplemented by an orderly and plentiful application of fertilizers and soil foods. This systematic enrichment of the soil has resulted in a steady amelioration in effects obtained. The average yield per acre on every kind of crop has risen for the empire as a whole by about 137 per cent within the past 40 years, as partly shown in the table below:

CROP	Produced in 1880, metric tons	Produced in 1913, metric tons
Potatoes	19,400,000	54,121,146
Rye	4,952,000	12,222,134
Wheat	2,059,000	4,655,156
Barley	2,076,000	3,073,254
Oats	3,700,000	9,713,678
*Hay	29,142,000	*29,154,194

* Owing to a great diminution of pasture land within that period.

By far the most important part of the crop in Germany is that of rye, wheat, oats, barley and potatoes. Rye predominates, not only as a matter of expediency for climatic reasons, but also because rye bread for general use as a chief food is preferred by the whole nation, rich and poor alike, to wheat bread. German wheat, besides, is somewhat deficient in gluten and hence less nutritious. Flour of rye and wheat mixed is liked best by many. In 1913 there were in Germany 16,035,347 acres devoted to rye culture, only 4,935,432 to wheat, 11,095,338 to oats, 8,530,037 to potatoes, 4,134,527 to barley. Despite the above brilliant showing in enormous increased yield, however, there has been, year after year, more urgent need of large imports of cereals, meats, etc., and this not only because of the rapid growth in population per square mile (that being now 317, according to the census figures of 1910), but because the diet of the nation had become more generous, not to say luxurious, with its rising wealth. The showing made, however, by the above table demonstrates clearly the superior methods, largely by means of the most efficient labor-saving machinery, employed in the empire in husbandry, methods which have enabled her to enlarge the total yield from her soil so enormously in spite of the fact that her agricultural population has not alone relatively but even absolutely diminished greatly, millions being diverted to industrial pursuits in town and city. Of other products, besides cereals and hay, beet root, tobacco and hops are noticeable. The yield in sugar beet is larger in Germany than in any other country; this is partly, indeed, owing to the granting of export bonuses by the government (so that Germans at home have to pay more for German sugar than they do abroad) and to other means of encouraging the industry, such as favorable legislation, but also partly to the excellent methods of utilizing the beet and growing the one variety giving, on each particular soil, the best all-around results in saccharine percentage and quantity, the average beet giving no less than from 17 to 22 per cent of sugar. The sugar beet crop has, of course, shown corresponding increase. It rose from 547,631 acres in 1882 to 1,369,062 acres in 1913, that being the last date on which reliable official figures were published. The hop production, on the other hand, decreased within the same period from 132,087 acres to 67,922; so did the tobacco acreage, from 59,944 acres to 35,452, but in yield much more, namely, from 52,197 tons to 10,671. Viticulture has not made any appreciable advance for many years. Vineyards exist, indeed, in the larger portion of Germany, from as far east as Silesia and the Kingdom of Saxony to the valleys of the Rhine and all its tributaries, notably the Main, Neckar, Moselle, Saan Nahe, etc., and to the sunny Suabian and Baden lowlands. But the wine really worth drinking is grown on a restricted territory. In 1913 vineyards covered 277,312 acres, and the wine made from the grapes grown averages in selling value about $27,000,000 per year, differing greatly in quantity and quality both, though the well-known vintages of Rhine and Moselle never fail to fetch good prices. It ought to be mentioned, though, that Germany imports right along twice as much wine as she exports, and that the ravages of the philloxera and other harmful insects have made wine-growing a rather risky occupation if depended on alone as a source of income.

From the detailed occupational census of 1907 the following facts and figures are cited as to the ownership of farm lands in Germany and other data: There were cultivated each by one household, farms between 2½ and 25 acres, 2,305,562; between 25 and 250 acres, 674,097; above 250 acres, 23,183. The total number of all farms, including those of less than 2½ acres and of over 2,500 acres, numbered 5,736,062, and the acreage amounted to 105,000,000. A peculiar feature of these tables is the overwhelming number of very small farms, those measuring less than 2½ acres (or one hectare) being 47 per cent of the total; and those below 25 acres in size being 87 per cent of the aggregate number. And another curious fact is that although numerically the owners of large farms (2,500 acres, or 1,000 hectares and over each) are but a handful, they possess almost one-fourth of the entire area of the tilled land, and that nearly all of these big land holders are to be found in that portion of Prussia denominated popularly Transelbia, i.e., those seven original provinces of Prussia lying east of the Elbe River and being the least progressive and politically the most dominated by the «Junker» class of landed-gentry, or by aristocratic capitalists. It tallies with these significant facts that over 85 per cent of the entire agricultural land in Germany is tilled and harvested by the owners, and less than 15 per cent by tenants or hired laborers. About 40 per cent of all the farmers cultivate their own land exclusively; a little over 30 per cent cultivate rented land beside their own, and the remaining 30 per cent cultivate altogether rented land. In these last-named respects there has been hardly any change within the past 40 years.

As to the breeding of livestock, that is also an important part of farming in Germany. The marshy plains of the north, the grassy slopes of hills and valleys in the west and south, and the moderate climate as a whole with its absence of rapid extremes, are admittedly well adapted to the cattle-raising industry. As a matter of fact, this branch has likewise improved on a large scale within the past two generations. The raising of sheep and goats is the sole exception to this, and the decline in this particular, which has been going on for several decades, has been due to the strong competition of Australia and Argentina, and to the low prices for wool incident thereto. However, in the plains of Brandenburg, Silesia and Saxony sheep-growing is still of importance. What has helped Germany in her endeavor to render profitable the breeding of cattle has been (besides protective legislation) the scientific cultivation of nutritious fodder grasses, such as lucerne, alfalfa, and the selection and improvement of the breeds themselves, including the fattening process for the market (rape oil cakes, sunflower cakes, etc., used). Cattle are raised principally in the rich marshlands along the North Sea (Holstein, Oldenburg, East Frisia) and in the fertile valleys and mountain slopes of Württemberg, Alsace-Lorraine and Bavaria. Horses are bred of various types; the heavy, hardy draft horse of Mecklenburg, Holstein, Hanover and West Prussia, the less weighty horses of East Prussia, Saxony and Hesse, etc. The government studs of Prussia, such as the ones in Trakehnen, Uelzen, Hanover, etc., are largely responsible for keeping up the rather high standard of horses throughout Germany, both for military and civilian purposes. Of horses, Germany owned, in 1912, 4,516,297 (an increase of about 50 per cent against 1882); of cattle, 20,158,738, in the same year (an increase of 25 per cent when compared with 1882); of sheep, 5,787,148 (a decrease of about 75 per cent); of goats, 3,533,970 (a similar decrease); and of hogs, 21,885,073 (an increase of about 40 per cent).

Some 34,500,000 acres of the area of Germany are covered with forest and the cultivation, preservation and renewal of which receives much attention by a large corps of specially trained men, the bulk of whom are in the government service. There are four forestry colleges in the country. But while the annual output of merchantable lumber and timber is very large, it is not large enough to satisfy the demand made for industry and the building trade, and part of this demand must be supplied from abroad. The larger woods and forests in most of the separate states of Germany belong to the different governments or are so-called «Crown lands.» These are usually under the care of special boards of management, and these also exercise certain rights of control and supervision over all forest lands, whether public or private. For the country as a whole, about one-third of all the wooded land is fiscal and about one-sixth is communal, while the «Crown forests,» i.e, owned by the various hereditary rulers and their families, measure 675,000 acres. The remainder is chiefly private property, subject, however, to a certain government control, the main object of which is to prevent the spread of conflagrations, of noxious insects, etc. The most valuable forest lands are to be found in the states of Bavaria, Saxony, Hesse, Baden and Württemberg, these being rich in leaf trees

— oak, beech, birch, ash, etc., while Prussia has the most extensive government-owned forests, mostly coniferous, such as pines and firs.

The German fisheries, for some unexplained reason, have remained far behind those of most of the empire's neighboring states and in the number of persons engaged in that branch of work are not very considerable. Still there has been improvement in recent years, and the annual German catch of the North Sea and the Baltic amounts to some $9,500,000 in value, about equally divided between the two seas. Cod and herring, besides some smaller fish (like sprotten, a species of anchovy), are taken both in the North Sea and in the Baltic. The imperial government has made some effort to increase the deep-sea fishing fleet and to encourage the consumption of fish and other sea food as a popular nutrient, but has met with scant success. As a matter of fact, about $20,000,000 of fresh, salted or canned fish are imported annually. The number of persons employed by the fisheries on both oceans amounts to but 42,000. In German rivers, ponds and lakes are found salmon, carp, trout, eels, pike, but no concerted movement to stock these waters plentifully and steadily has yet been made.

Bibliography.— Arndt, E., 'Deutschlands Stellung in d. Weltwirtschaft' (Leipzig 1908); Barker, E. M., 'Modern Germany' (London 1912); Meyer, H. E., 'Deutsche Volkskunde' (Strassburg 1898); Partsch, R., 'Central Europe' (New York 1903); Ratzel, F., 'Deutschland' (Leipzig 1898); Rauchberg, Otto, 'Die Landwirthschaft im d. Reiche' (in Vol. XV of *Archiv für soz. Gesetzg. ü. Statistik*, Berlin 1900); Schierbrand, Wolf von, 'Germany: the Welding of a World Power' (New York 1902); Thiele, Ad., 'Deutschlands landwirtschaftl. Klimatographie' (Bonn 1895).

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23. MONEY, BANKING, EXCHANGE. The modern German monetary system originated with the foundation of the German Empire. In 1871, gold was declared the standard of value. The unit of value is the mark which is divided in 100 pfennig. In gold 4 marks are equal to $0.95284, or 1 mark is equal to 23.82 cents United States gold. For statistical purposes $1.00 is generally regarded as four marks. Gold has been coined and not melted down again until 1915, to the amount of 5,120,000,000 marks (710,000,000 marks in 10 mark pieces). Of these 5,000,000,000 marks a large quantity has been exported or used up in industries, probably about one-half. During the war, of course, no gold is in circulation in Germany, but it is hoarded either in the federal bank or privately. More than 2,500,000,000 marks gold — German coins, foreign coins and bars — have been concentrated in the federal bank. Silver has been coined to the amount of 1,160,000,000 marks.

MONEYS

Federal Treasury Notes — Reichskassenscheine.— In withdrawing existing paper money of the different states, united in 1871, 120,000,000 marks ($30,000,000) Federal Treasury notes were issued. By a law of 1913, the amount of Treasury notes was to be doubled and a corresponding amount of gold was to be withdrawn from circulation and deposited as a special War Reserve Fund. When war broke out the law had not been carried out to its full extent. The Treasury notes are now circulating in denominations of 5 and 10 marks.

Federal Loan Bank Certificates — Darlehenskassenscheine.— The issue of these certificates is a war measure to meet the demand of quick money by the citizens on their loanable property. The conditions being not very favorable the amount of these certificates has not become very large. By the end of 1914 $329,000,000 worth of these certificates had been issued, but being replaced constantly by bank notes, only one-third of that amount was actually in circulation.

Bank-Notes.— There are five banks of issue, the Federal Bank (Reichsbank), the Bayerische Notenbank, the Sächsische Bank, the Württembergische Bank and the Badische Bank. The notes of the Federal Bank are in circulation all over Germany, while the circulation of the notes of the other banks is more or less restricted to their state territories. Moreover, the issue of the notes of the Federal Bank may be regarded as unlimited for practical purposes. So the Federal Bank holds a predominant position, while the four other banks are only of local importance and their special and differing regulations may be disregarded. The Federal Bank is a private joint-stock company with a fully paid capital stock of $45,000,000, and reserves of $20,000,000, but regulated in its scope of business by law and controlled by the government, the director being nominated by the Imperial Chancellor. Bank notes are issued in the denominations of $250, $125, $25.00, $12.50 and $5.00.

Above the amount of lawful money in the possession of the banks of issue, notes can be issued not subject to any tax, to the amount of $155,000,000 generally, and $205,000,000 during one week at the end of each quarter of the year (of this $137,000,000 generally and $187,000,000 at the end of the quarter are issued by the Federal Bank). Above that amount the Federal Bank is entitled to issue notes but against payment of a 5 per cent tax involving an effectively restrictive discount rate of at least 5 per cent on first-class commercial paper, and the total amount of notes outstanding is not allowed to exceed three times the amount of cash in the hands of the bank. The circulation of bank-notes is the elastic varying element in the German monetary system. The principle of an elastic but gradually restrictive note issue as stipulated by the Bank Law of 1875, has since been introduced in most modern monetary systems, last of all in the monetary system of the United States by the Federal Reserve Act.

The Latent Monetary Crisis in Germany, 1900–14.— During the last few years before the war the German monetary system has undergone very considerable changes. Before 1900, the policy of the Federal Bank, under the presidency of Koch, was more that of a central credit than that of a central currency institution. The gold holdings of the Federal Bank were dangerously small compared with the enormous foreign trade which was, moreover, mostly financed by French short call money and British trading firms. Since 1900 or thereabouts, the upward tendency in prices especially of raw materials and foodstuffs imported by Germany, combined with the natural increase of population and the important surplus of immigration over emigration, and a growing industrialization, demanded a quick increase of money in circulation. Since new money can be created in Germany only by coining new gold or depositing new gold in the Federal Bank (besides the automatically restrictive emergency money of the bank-notes) and gold is not produced in Germany in any considerable quantity but must be imported as needed like merchandise, Germany faced a difficult and almost dangerous situation from 1900 to 1914 in meeting the increased demand for money, which held a large part of the non-dutiable note-issue in constant circulation restricting the amount of reserves or emergency money (in 1913, of the total amount of that note-issue of $155,000,000, $151,000,000 were on the average in circulation). In order to meet this latent crisis, gold was bought and imported like merchandise, burdening the trade with the task of paying for these gold imports. As late as 1907, the amount of gold in the Federal Bank touched the low mark of $149,000,000 (with no other strong gold reserves in private possession available). Gold purchases abroad during the years 1908–13 amounted to $326,000,000 (in 1913 to $79,000,000), and the amount of gold in the hands of the banks rose to an average of $199,000,000 in 1908–10, and of $267,000,000 in 1913. In order to strengthen the national gold reserve, gold was replaced by paper in the circulation. For that purpose the notes in the small denominations of $12.50 and $5 were created and bank-notes were declared to be legal tender but redeemable against gold on presentation (Law of 1906). In order to adjust the amount of emergency money to the enormous development and to the increased demands of commerce and industry the non-dutiable note-issue was almost doubled (Laws of 1901 and 1909) as compared with 1875.

Banking.

There is no state concession of banking in Germany and no special bank law (besides that regulating the note-issuing banks) since the foundation of the empire. The banks have been able to develop their own methods of business and standards of safety. But there is one bond uniting and regulating all credit resources of Germany — the elastic emergency and credit currency which is handled in a liberal, strict and cautious manner by the Federal Bank in order to foster industry and commerce. In performing their task of stabilizing the established national wealth by creating new wealth the German banks combine the functions and interests which in America are generally divided among banks and bankers, trust companies, promoters, stock dealers and brokers. The large German banks accept deposits on the one hand, carry on a circulation and check business, and give credit for exchange, mercantile and other securities as in the ordinary bank routine, while on the other hand they buy and sell stocks for others and on their own account, engage in all sorts of financial, industrial and mercantile undertakings, promote the establishment or development of industrial enterprises and undertake the flotation of public and industrial loans of every kind. As a whole the German system has proved to be safe and sane, and even the large depreciation of private property in Germany caused by the heavy increase in taxation of every description during the last few years preceding the war did not undermine and not even severely injure the prosperity of the banks.

The Modern Development of Concentration and Expansion.— Not only the task of distributing the large risks which of course have to be incurred by the great German banks but the very fact of their intimate connection with industrial and commercial enterprises, with production, distribution and consumption all over Germany and in the trade between Germany and foreign countries, induce the banks to strengthen their means as far as possible and to expand their business connections geographically. The statistics available are restricted to joint-stock banks; there are other very large and much older banks in Germany which are owned by individuals representing family estates, like Bleichröder and Rothschild.

Increase of the Home Resources of the Banks.— The five greatest German joint-stock banks have increased their capital stock from $71,000,000 in 1888, to $152,000,000 in 1898, to $255,000,000 in 1914, or an increase of 225 per cent between 1888 and 1914. That amount has not only been fully paid in (conforming with the requirements of the German laws), but since the emission price of the new shares was much above the nominal value, the actual increase of capital was much larger, the difference between the nominal value and the actual value being assigned to the reserve funds and constituting the larger part of them. The reserve funds of these five Berlin banks amounted to $81,000,000. Besides the open reserves there are very large «silent reserves» which have grown out of the intimate connection of the banks with the industries, simultaneously with the growth of these industries.

Systematic Concentration of Deposit and Savings Money.— To provide the industrial and commercial development with the necessary capital the German banks have to overcome both the shortage of capital in Germany and the German legislation which restricts the capital investments of a productive character by forbidding the issue of industrial and commercial shares in small denominations (generally less than $250). They have succeeded in doing so largely by the development of the deposit business, spreading a system of deposit-offices over the large cities of Germany and supplanting partly the savings banks by their compliant methods of business. Thus deposits in the five leading Berlin banks have increased from $166,000,000 in 1896, to $693,000,000 in 1907, to $956,000,000 in 1913, or an increase of 470 per cent from 1896 to 1913, and the relation between capital stock plus reserves and deposit money has become almost 1:3. Provincial banks have followed later in that kind of business and their inability to develop their deposits to a corresponding degree is one of the reasons for the rapid concentration in German banking.

Territorial Expansion.— First, an expanding bank by opening a new branch, or buying some local bank or establishing a community of interest with a local bank preserving some sort, or at least appearance, of local independence, in another city has gradually spread a net of offices over a large territory. Out of these organizations have grown up great banking concerns by combination of one of the great Berlin banks with important provincial banks, these great Berlin banks being able to assert their superiority over provincial institutions in consequence of their superior strategic position. Each of these banking concerns constitutes something equivalent to a Federal state of banking interests which stretches out its power over the whole of Germany. It has been proved by experience that to make such a combination successful for both parties the question of supremacy must have been settled definitely in favor of the stronger, that means the Berlin bank. It can be stated that these federations are only an intermediary state of things and lead finally to amalgamation. The mergers of some of the most important provincial banks with great Berlin banks were already the prominent feature of German banking development during 1913–14 (of the Schaaffhausen Bankverein at Cöln with $36,000,000 capital with the Disconto Gesellschaft at Berlin, and the Bergisch-Märkische Bank at Elberfeld with $20,000,000 capital with the Deutsche Bank at Berlin). That process of amalgamation has especially been favored by the war, for instance the Deutsche Bank until the end of 1916 having extended by amalgamation of great provincial banks to a stock capital of $125,000,000.

The five leading Berlin banks are the Deutsche Bank with $91,000,000 capital and reserve, the Disconto Gesellschaft with $95,000,000 capital and reserve, the Dresdner Bank with $65,000,000 capital and reserve, the Bank für Handel und Industrie with $48,000,000 capital and reserve, and the Berliner Handelsgesellschaft with $36,000,000 capital and reserve. Of these five banks the first three are the most progressive while the Berliner Handelsgesellschaft is deliberately preserving the type of an old-fashioned commercial bank. The Deutsche Bank commands the largest amount of deposits, while the Disconto Gesellschaft and the Dresdner Bank, for a long time inferior to the Deutsche Bank, have during the last few years before the war made good headway in equaling it. The figures given above comprise the increase in capital effected in 1914.

Combination Among the Leading Banks. —Among the leading banks as representatives of their banking concerns alliances are frequently formed for some special purpose of a more or less lasting character, just as between independent states, say the financing of some large enterprise, or the floating of a loan, home or foreign.

Creation of German «Foreign Banks.»— In promoting the commerce with foreign countries «foreign banks» have been created mostly by one or more of the leading Berlin banks. The most important of these foreign banks with the amount of capital stock and reserve are the Deutsche Übersee Bank ($10,000,000), operating mostly in South America, the Deutsche Orientbank ($8,000,000), the Deutsche Südamerikanische Bank ($5,000,000), the Deutsch-Asiatische Bank ($5,000,000), and the Brasilianische Bank für Deutschland ($4,000,000).

The growing concentration and expansion of some large banks have caused a gradual disappearance of the small banker all over Germany.

The position of banking toward industry and commerce is very strong. In very many of the important industrial and commercial firms a high official of one of the leading banks is a member of the board of directors or trustees, and the banks are continually extending their influence, using partly their control of credit, partly their already stabilized control over other firms. Only a few very large industrial and commercial concerns have been able to preserve their independence or even to dictate their terms in their relations with the banks. The dividends paid on the nominal capital by the five great Berlin banks in 1913 were between 12½ per cent (Deutsche Bank) and 6½ per cent (Bank f. Fl. u.). The policy of the banks in fixing the dividends is very conservative and cautious; the rate of dividends being only raised above the customary level if it can be reasonably expected that the higher level can be maintained.

Mortgage Institutions.— In North Germany the credit on rural property is generally provided by institutions of an official or semi-official character, the most important of these are the «Landschaften» for the landed aristocracy, founded on co-operative principles. The credit on rural real estate in South Germany and on urban real estate in North and South Germany are provided by mortgage banks. By the law on mortgage banks of 1899, they are regulated in their scope of business and in the issuing of bonds, and the government is entitled to exercise the right of control on every mortgage bank at any time. The total amount of bonds issued on real estate property was, in 1912, $4,260,000,000, of this (in 1913) $2,750,000,000 had been issued by mortgage banks.

Savings Banks.— Savings banks are mostly municipal institutions and are used by all classes of the people. The amount saved — $4,700,000,000 — and the number of accounts — almost 23,000,000 — are both striking. The capital is mostly used in buying bills of exchange, in mortgages and mortgage bonds, and by recent legislation the banks are compelled to have invested a considerable part in bonds of the empire and the states.

Co-operative Credit Institutions.— Germany was leading in developing the methods of furnishing the small artisan in the town and the small farmer with productive credit. There were, in 1908, 16,100 credit corporations with 2,203,000 members which were organized in 60 central credit corporations and 33 associations for auditing. The importance of these latter institutions rests on the power of the government to transfer to them its right of supervising and controlling the small individual corporations, irrevocably unless gross misconduct has been proved. The concession of this right to the leading Polish bank in Posen by the Prussian government has become the legal basis of the most important financial organization of the Prussian Poles. A powerful credit and rural banking system has grown up on this basis and is backed by the Central Co-operative Bank (Zentralgenossenschaftskasse), a Prussian state institution with a capital of $19,000,000 in 1909. In 1901 money to the amount of

$223,000,000 was paid into the bank on current account, while the total turnover of the bank was $4,100,000,000.

The Federal Bank as the Central Credit Institution.— The backbone of the credit system is the Federal bank in its right of an elastic practically unlimited but restrictive note issue. There was never any danger of a cash crisis in modern Germany which was the critical point of the economic system of the United States up to the creation of the Federal Reserve Bank system. First of the banks, the Federal Bank has spread a system of branch offices all over Germany and has now established branches in about 490 cities. Based on this branch system it has established a clearing house system uniting all Germany; in 1913 the amounts of payments made in that clearing house business amounted to $47,000,000,000, as against $20,400,000,000 in 1900, and $7,100,000,000 in 1890; and it has concentrated a very large part of the trade in bills of exchange in its hands during the last few years, especially in bills of exchange on foreign places; the number of bills bought by the Federal Bank maturing in Germany being 5,400,000 in 1913 as against 4,500,000 in 1901, and to the amount of $2,900,000,000 in 1913 as against $1,500,000,000 in 1891, while the number of bills of exchange on foreign places was in 1913, 100,000, as against 23,000 in 1901, and to the amount of $280,000,000 in 1913, as against $40,000,000 in 1901. These bills are generally sold to the Federal Bank some few days, now by statute of the Federal Bank at least 10 days, before maturity. Having grown up as the useful servant of the private business interests while their means were very limited, even somewhat disregarding its duties as a political and currency institution, it is now a powerful master even toward the largest of these bank concerns representing the public interests against their private interests. So during the last few years it has forced from the great banks the publication of balances every two months, the enlargement of their deposits free of interest with the Federal Bank, and the gradual increase of the cash held by the banks against their deposits until one-tenth of the amount of those deposits was to be reached. Further, in connection with the mortgage institutions the Federal Bank has concentrated the cash transactions on the mortgage market. And by the medium of the Central Co-operative Bank it is closely connected with the co-operative credit system. An advisory board of the president of the Federal Bank is composed of the leaders of the most important credit institutions of the empire.

Exchange.

International Position of the German Stock and Produce Exchange.— The German stock exchange has not been able to secure an international position equal to those occupied by the stock exchanges of London, Paris and New York. And likewise the German produce exchange has not succeeded in getting a leading position equal to the produce exchanges in Great Britain and America.

Besides the scarcity of German capital power and the unfavorable geographic position of Germany both for production and distribution one reason more will be found in the very marked distrust or open hostility displayed by the agrarian and socialist majority of the Reichstag and backed by the popular judgment against the man operating in the stock or produce exchange. Besides the Berlin stock exchange, which is of course the most powerful, the stock exchanges of Frankfort-on-Main and Cologne are important and largely independent, while the stock exchanges at Leipzig and Hamburg are strong but more closely connected with Berlin. Concerning the produce exchanges, beginnings have been made to build up international markets in Germany in some of the leading staple products, for instance wool, at least for continental Europe.

German Capital Investments.—The amount of stocks and bonds admitted at German exchanges in 1911–13 ($2,878,000,000) has not risen considerably above that of 1899–1901 ($2,454,000,000), but government borrowing already large in 1899–1901 — about 31 per cent of the whole amount — has increased very substantially (to 41 per cent), both in home and foreign loans. The investments in bonds of cities has decreased absolutely and of course even more relatively (from 38 per cent to 30 per cent). And so have decreased investments in stocks and bonds of banks and of railroads, already small in 1899–1901 (from 6 to 3 per cent and from 10 to 6 per cent). Industrial stocks and bonds, both domestic and foreign, have increased (from 17 to 20 per cent). The investments in bonds and stocks admitted at the German exchanges constitute, however, only a part of the total German capital investments which are considered to amount to about $2,000,000,000 every year.

According to official compilations of German capital investments in foreign countries the amount was between $1,759,000,000 and $1,934,000,000 in 1898, and between $2,007,000,000 and $2,306,000,000 in 1907–08. In 1909, the investments in the United States and Canada were estimated at $687,000,000, in Central America, $272,000,000; in the countries of the West Coast of South America, $131,000,000; of the East Coast, $362,000,000; in Africa, $332,000,000; in Turkey, $81,000,000; in Persia and British India, $19,000,000; in Eastern Asia, $106,000,000; in Southeastern Asia, $106,000,000; and in Australia and Polynesia, $87,000,000.

Taxation.— In principle the taxation by the empire is indirect, by the states direct, while the communal taxation is mostly fixed in per cent of and additional to the state taxation. Both in the states and the communes the income derived from productive enterprise (mostly railways, forests and mines in the case of the states, trolley cars, water, gas, electric power in the case of the communes) forms an important item. The development of the inheritance tax and the general introduction of the income tax as the basic duty of the system of direct taxes are the prominent figures of the modern development. The increase in taxation during the last few years before the war was very large, almost injuring the needs of production. It has been estimated that every German has, on the average, to work two months in the year for the empire and the states and the other public bodies. Even before the increase in taxation during the last few years the taxation already borne by the largest and most prosperous German corporations in the coal and iron industries amounted from 60 to 75 per cent of the total profits. It is a splendid proof of the economic excellence of the German system of social insurance as introduced by the empire, and of the policy of social welfare as practised by the states and the communes, that in spite of these taxes the German industries were, generally speaking, increasingly prosperous.

Bibliography.— Heilfron, Ed., 'Gesetzgebung über Geld-Bank, und Börsen-wesen' (Berlin 1911); Jolles, Leo, 'Im Reich des Geldes' (ib. 1915); 'The Reichsbank, 1876–1900' (Government Printing Office, Washington, D. C., 1910); 'The German Bank Inquiry of 1908' (2 vols., ib. 1909); 'Miscellaneous Articles on German Banking' (ib. 1910); 'Die Reichsbank, 1876–1910' (Jena 1912); Plenge, J., 'Von der Diskontpolitik zur Herrschaft über den Geldmark' (Berlin 1913); Riesser, J., 'The German Great Banks and their Concentration in Connection with the Economic Development of Germany' (Washington, D. C., 1911); Wiewiorowski, S., 'Einfluss der deutschen Banken-konzentration auf Krisenerscheinungen' (Berlin 1912); Wolff, S., 'Das Gründungsgeschäft im deutschen Bankgewerbe' (Stuttgart 1915).

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24. TRAFFIC AND TRANSPORTATION IN GERMANY. Germany's railroads are nationalized and the profits they make are devoted to governmental purposes, thus lessening the burdens of taxation to that extent. In the year 1911 the total freight earnings of German railroads were $516,303,000 or $8 per capita or $40 per family of five. The net profit of the German railroads of $160,000,000 is devoted to governmental purposes.

The average passenger fare for a second class ticket, which compares favorably with the ordinary day coach in America, is 1.8 cents, while the first-class rate is 2.5 cents per mile, the third class 1.1 cents per mile, and the fourth class but 0.8 cent per mile.

Although the German railroads are owned by the various states, they are under the administration of the empire. The supreme authority in railroad administration is the Bundesrat (Senate of the empire). The head of the state railroads in Prussia is the Minister of Public Works, appointed by the king, while the Reicheisenbahn Amt (Imperial Railroad Bureau), the members of which are appointed by the emperor, exercises general supervision over the whole system. General conferences are held from time to time in which the various railroads are represented in proportion to their mileage. A committee of the conference consisting of 16 members selected by chambers of commerce and boards of agriculture and constituted of five representatives of manufacturing interests, five of agriculture, five of distributing and commercial interests and one of the Bavarian government, decide upon rates, as worked out by a permanent rate commission. There are similar district boards of conference for more local problems. For the physical operation of the roads, there is a central department at Berlin which supervises equipment and serves as a centre for administration, the several states having administrative departments for their own portions of the roads.

To the shipper, the railroads of Germany are all one system, and there is no more expectation of receiving favors from them than there is of receiving favors in America from the post office. As the roads are the property of the states, they are made to serve the public interest, and the rates are so adjusted as to cause the roads to have a stimulating effect upon general business conditions.

Thus, for example, shipments from abroad if made in German vessels are given preferential rates on canals and railroads in Germany. This amounts to a ship subsidy and encourages the ship-building industry. Again, special rates are often made so that the geographical location of a factory will not be a handicap to its business, and this preference enables factories to be operated in cities and districts where they could not otherwise exist, making industry more widespread and contributing to the prosperity of the country as a whole rather than to congested districts. The underlying principle is to use the public utilities as an instrument to promote the general welfare as well as a means of transportation.

Although the railroads of Germany are highly developed, the building of canals, waterways and harbors has been carried out upon an enormous scale, and is planned far ahead in a vast and far-reaching system. The similar developments in other countries are entirely overshadowed. When completed, canals will unite the Rhine, the Danube, the Oder, the Vistula, the Elbe, the Weser and the Meuse, of sufficient dimensions to carry large craft. The navigable waterways of Germany amount to 8,600 miles, of which 2,200 miles are in canals. In 1911 there were transported 408,870,000 tons of goods on railroads and 76,632,000 tons on waterways, or more than one-sixth of the amount carried by rail. Berlin, as the result of canal building, now has an in and out traffic of 8,000,000 tons, and though 400 miles from the sea is a seaport only exceeded by the North Sea ports and certain cities on the Rhine. In a few years Berlin will be connected by canals with the Rhine on the west and the Danube on the east, and as a result vessels will pass from the North Sea to the Black Sea. The building of many of Germany's canals is carried out in the face of great engineering difficulties, which are, however, overcome and highly efficient systems of waterways constructed. In some instances canals are elevated and placed above railroads and streets, and instead of locks, a whole section of the canal with water and vessel is lifted on the elevator principle, to the next water level, effecting a great saving of time. The canals carry the heavy bulk freight, such as coal, iron ore, lumber, grain and the heavier articles of commerce on which very low freight rates are charged. The railroads, canals, waterways, overseas shipping and ports are operated in conjunction with each other and ample facilities are provided for transshipment of freight. The public has the full benefit of the cheapest forms of transportation, with its consequent stimulation of industry.

One of the great advantages enjoyed by

German commerce is in the free ports of Hamburg, Bremen and Lübeck. They were, in former centuries, independent states and controlled the Hanseatic League, the dominating force in mediæval commerce of the north. They came into the German Empire retaining many of their privileges, among them being the right to maintain free ports; that is to say, ports in which cargoes may be received, transferred, dealt in and reshipped independent of the tariff barriers of the rest of the nation. This freedom from tariff restrictions made England the mistress of the seas and it has made the free ports of Germany the rivals of England as places for the exchange of goods from all parts of the world. While in tariff countries goods may be put into bond and taken out again for reshipment to other countries without paying duty, the inconvenience is so great that vessels from all parts of the world prefer free ports in making their exchanges and will go hundreds of miles out of their courses to avoid the inconveniences of tariff regulations. This has made Hamburg one of the largest ports in the world, exceeding Antwerp and rivaling New York, although its geographical position is far less favorable. In administering the free ports, custom officials regard the free portions of the harbor as foreign territory, and though goods are handled and transshipped on the piers and docks and stored in the warehouses, nothing is admitted to the tariff-protected part of the port until the duty is paid. In this way Germany enjoys the advantages to commerce of free trade and the protection to her industries of the tariff.

Germany's progress during the past generation is shown by the figures for trade and transportation and overseas shipping. The business of the post-office increased from 1,303,400,000 letters in 1887 to 5,994,300,000 in 1911, or 359 per cent, and the number of post-offices increased from 19,476 to 40,987 or 110 per cent. During the same period the increase of population was but 37½ per cent. The number of post-offices in Germany per 100,000 population in 1909 was 79, in the United Kingdom 53 and in France 34. During the same period, 1887 to 1911, the number of telegraph offices increased from 14,565 to 46,444 or 218 per cent, while the number of messages increased from 17,860,000 to 49,643,000 or 178 per cent. The number of telegraph offices in Germany per 100,000 population in 1909 was 69. The receipts of the post-office from postage and telegraph charges amounted in 1887 to $47,500,000 and by 1911 they had increased to $196,000,000. The railroad system has increased markedly in the past generation, as is shown by the following table:

	1885	1911	Increase in percentage
Length of railroads (in kilometers)	37,190	59,763	60.7
Capital invested (million marks)	9,722	17,833	83.4
Officials and laborers	333,439	713,187	113.9
Locomotives and power cars	12,450	28,088	125.6
Passenger cars	22,735	59,857	163.3
Freight and express cars	250,640	596,763	138.1
Gross receipts (in million marks)	997	3,271	218.0
Freight carried (in million ton kilometers)	16,600	61,870	272.7
Passengers carried one kilometer (in millions)	7,932	37,855	377.1

The railroad development in Germany in length of line operated shows an increase from 1890 to 1911 of 42.6 per cent. In that year the total mileage of railroads in Germany was 38,462 miles.

The operations of railroads in the principal countries from 1895 to 1910 may be seen in the summary given in the table above.

Comparative Railroad Development.

	Capital invested (in million marks) end of		Passengers carried one kilometer (in millions)		Freight carried one kilometer (in million tons)		Total revenues (in million marks)	
	1895	1910	1895	1910	1895	1910	1895	1910
Germany	11,407	18,664	14,344	37,613.7	25,486.4	53,803.8	1,513.9	3,092.3
England	20,022	26,370	....	....	....	....	1,730.2	2,485.5
France	12,471	15,099	10,671.0	20,976.8	12,914.1	27,733.0	1,003.7	1,813.7
United States	46,595	77,352	19,940.4	54,846.0	139,379.6	425,076.7	5,217.1	13,211.5

The inland waterways of Germany including navigable rivers are 12,226 miles in length. Those of the United Kingdom are 8,127, France 8,015 and the United States 20,915 miles. In the year 1887 there were 20,390 vessels engaged in inland navigation in Germany, 19,989 of such vessels having a total capacity of 2,100,000 tons. In 1907 there were 26,191 of such vessels having a carrying capacity of 5,900,000 tons. In 1911 the traffic on the inland waterways was 76,000,000 tons, or one-sixth of the railroad tonnage.

The development of Germany's overseas commerce is even more striking than that of her inland waterways. In the period from 1888 to 1913 her tonnage more than doubled.

In 1888 she had 3,034 sailing ships manned by 21,053 sailors, having a net register of 758,359 tons. By 1913 the number of sailing vessels had decreased to 2,420, having a net register of 396,904 tons and manned by 12,980 sailors, but her steam vessels had increased from 717 in 1888, having a register of 470,364 tons and manned by 15,856 sailors, to 2,098 vessels having a net tonnage of 2,655,496 tons and manned by 63,713 sailors. In addition she had in 1888, 60 sea-going lighters of a net register of 11,459 tons, manned by 167 sailors, while in 1913 there were 332 lighters, having a register of 101,324 tons and manned by 1,053 sailors. The total increase was from 3,811 ships, having a registered tonnage of 1,240,182 tons, manned by 37,076 sailors, in 1888, to 4,850 ships, having a register of 3,153,724 tons, and manned by 77,746 sailors in 1913. Thus the tonnage increased two and one-half times and the number of sailors more than doubled. The tonnage of steam vessels which was hardly more than half of that of sailing vessels in 1888 had increased to seven times as much in 1913, which is even more important for purposes of traffic than would appear from the figures since the steam vessels, making greater speed, are able to make a greater number of round trips in a year than are the sailing vessels. More than one-quarter of the gross steam tonnage on 1 Jan. 1913 was represented by steamers less than five years old while more than half was by steamers less than 10 years old. This indicates the rapidity with which the steam vessels have been constructed. The sea-going traffic at German ports has been developed much more rapidly than has the same traffic elsewhere in Europe, as will be seen from a comparison of the figures for the year 1887 with those of 1911. In 1887 the number of merchant vessels carrying cargoes arriving in Germany was 29,359, carrying 1,675,498 registered tons of cargo, while in 1911 the number of vessels was 56,544, carrying 5,397,913 tons of cargo, an increase of more than 300 per cent. The number of outbound vessels in 1887 was 28,564, carrying 1,661,471 register tons, while in 1911 it had increased to 55,795 vessels, carrying 5,495,791 register tons.

For all other European ports, including Great Britain, the number of vessels arriving in 1887 was 18,891, carrying 5,917,242 tons of cargo, while in 1911 the number was 41,443, carrying 15,330,754 tons. The number of outbound vessels at all other European ports in 1887 was 14,995, carrying 4,467,353 tons of cargo, while in 1911 the number of vessels had increased to 23,441, carrying 8,975,655 tons, or a little more than double the tonnage. During the same period Germany had more than tripled her export tonnage. Germany's improvement in her commercial fleet is illustrated by the following comparisons, taking the figures for 1885 and for 1911: In 1885 Germany had 3,438 sailing vessels of a capacity of 854,900 register tons, while by 1911 the number of sailing vessels had decreased to 2,723 with a capacity of 510,000 tons. The United Kingdom had in 1885 sailing vessels to the number of 17,018 with a capacity of 3,457,000 register tons, but by 1911 the number had decreased to 8,714 with a capacity of 971,700 tons, a much more rapid decrease than that of Germany. The United States had in 1885 sailing vessels to the number of 18,564 with a capacity of 2,771,000 gross tons. The number of sailing vessels in 1912 had decreased to 10,969 with 2,147,700 gross tons capacity, a smaller decrease than either Germany or the United Kingdom. The decreases in sailing vessels was largely due to the building of steel hull steam vessels during the period in question, consequent upon the cheapening of the processes of steel manufacture. The decrease in the number of sailing vessels in the United States was correspondingly less, due to the stagnation in shipbuilding and the retaining of the old vessels in use.

The next two countries of importance in sea traffic are Norway and France, together equal to Germany, but both suffered decreases in aggregate tonnage during the period mentioned.

In the development of what are termed inland harbors Germany has progressed. This is especially noticeable on the Rhine where a great traffic has been built up through encouragement to navigation by the cities benefited, acting under the direction of the government in the working out of the system. The largest harbor on the Rhine is the Duisburg-Ruhrort harbor, in reality a group, it being a transfer point for coal from railroad to river. In 1907 the traffic was 31,000,000 tons or as great as Hamburg's overseas traffic. The harbors at Mannheim–Ludwigshafen on opposite sides of the Rhine have a traffic greater than the seaward traffic of Bremen. Other prominent harbors are at Crefeld, Mühlheim, Cologne, Düsseldorf, Worms, Carlsruhe, Frankfort, Offenbach (on the Main) and Strassburg. The rivalry between these cities keeps the harbor facilities constantly up to the highest point of efficiency. The larger part of the Rhine traffic is inland bound and iron ore and grain form two-thirds of the total, while coal for export forms half of the outward traffic. Two-thirds of the Rhine traffic is in foreign exports and imports and one-third in domestic goods. In 1907 the total Rhine traffic was 64,500,000 tons, an increase of 400 per cent over 1885. The chief articles of the Rhine traffic are wheat, rye, iron, coal, coke, manufactured iron, soda, salt, stone, sand, gravel, brick, wood, cement, fertilizer, petroleum, coffee, fruit, wine, tobacco and machinery. The increase in the river traffic is shown by the following tables, selected from the reports of various harbors, as indicating the increase at harbors of different sizes.

MANNHEIM

1870	41,000 tons
1893	2,200,000 tons
1901	5,145,000 tons
1909	6,085,000 tons

RHEINAU

1901	562,000 tons
1903	1,011,000 tons
1909	1,797,000 tons

LUDWIGSHAFEN

1870	135,000 tons
1909	2,178,000 tons

The whole German system of traffic and transportation, rail, inland waterways and overseas, is all one co-ordinated organization, each element of which is developed in its proper relation to the whole and each of which is employed to promote the prosperity of the other and of the country at large.

The preferences in rates on the inland lines promote the overseas traffic, which proves a consequent stimulus to the building of liners and other vessels whose passenger traffic in turn is of great value to the railroads. An endless chain of benefits is thus established for an efficient traffic and transportation system, not only highly profitable in times of peace, but effective in times of war for the national defense.

Bibliography.— Helfferich, Dr. Karl, 'Germany's Economic Progress and National Wealth' (Berlin 1914); Howe, Frederic C., 'Socialized Germany' (New York 1915);

Koester, Frank, 'The Price of Inefficiency' (New York 1913) and 'Secrets of German Progress' (New York 1915); Dresdner Bank, 'Germany's Economic Forces' (Berlin 1913); 'Deutschland als Weltmacht' (Berlin 1911).

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25. THE GERMAN ARMY. Historical Outline.— Modern military systems trace their origin back to the general introduction of fire-arms, which toward the end of the 15th century rendered the knight in armor and the whole consequent structure of feudalism obsolete. France organized companies of mounted orderlies, forming the first germ of the standing army, Spain created a large army and armies of German and Swiss mercenaries appeared. The feudal levy was displaced as a military force by armies of hirelings, particularly during the Thirty Years' War (1618–48), of a licentious character.

In Brandenberg and Prussia the idea of recruiting the army from the people began early to take form. The Great Elector (1640–88) was the first to assign regiments to definite districts from which their recruits and reserves were to be drawn in time of war. The Great Elector laid the foundations for the future power of Prussia by rigid economy in civil and military administration, and the raising of the national spirit of the Germans which had fallen to a very low ebb. His son and grandson, Frederick I and Frederick William I, continued his policies until the army was augmented to 84,000. The corps of the officers was selected from the nobility and carefully educated, forming the mainstay of the system.

When Frederick the Great came to the throne in 1740 Prussia thus had an excellent army and a good system of recruitment which enabled him to keep up his forces under the strain of the Seven Years' War, inspired as it was with a strong national feeling and enthusiasm by the monarch, in opposition to the enormous odds of the coalition of Austria, France and Russia.

After his death, however, abuses having crept in, the spirit of the army departed, and Napoleon, the great master of the art of war, with a national army, new methods, implements and strategy, destroyed the superannuated Prussian armies and humbled the state. By the Treaty of Tilsit, Prussia agreed to keep her army down to 42,000 men.

Reforms were introduced, recruits were discharged after one year's training, and in 1814 universal obligation to military service was introduced, so that by 1815 the armies under Blücher, Gneisenau and York rose to 250,000 men.

In the slow period of recuperation after the Napoleonic wars progress was only gradually made. In 1859 the standing army consisted of 140,000 men and in 1860 the reorganization raised the annual levy from 49,000 to 63,000. In the wars of 1864 and 1866 Prussia was able to bring 600,000 men under arms and become for the second time in history the model for the armies of the world. In the war of 1870–71 with France, considerable over a million men were placed in the field, and on 18 Jan. 1871 the German Empire was proclaimed in the halls of Versailles. The essential details of the German military system only can be given here.

Liability to Service and the System of Its Application.— Every male German is liable to military service. Only members of the ruling family and mediatized princely houses are exempt. Evasion of service by means of substitutes is not permitted. The obligation to service exists between the ages of 18 and 45 years inclusive, and contemplates service either (1) in the army, navy or (2) in the Landsturm.

Service in the army begins at the end of the 20th year and terminates on the 31st of March of the calendar year in which the man completes his 39th year of age.

The first levy of the Landsturm consists of all men from the end of the 17th year to the 39th year who have not served in the standing army in peace times. The second levy includes all up to the end of the 45th year, whether they have or have not served in the army. The Lansturm is intended for home defense, but in extraordinary cases may be utilized to recruit the army.

Service with the army may be with the colors, followed by the reserve and first and second levies of the Landwehr or in the Ersatz reserve. The periods of service in times of peace are as follows:

SERVICE	Cavalry and horse artillery	All other arms of the service
With the colors	3 years	2 years
In the reserve	4 years	5 years
In the Landwehr, 1st levy	3 years	5 years
In the Landwehr, 2d levy	9 years (about)	7 years

Men in reserve are simply on furlough and return to the colors when called for.

Volunteers of sufficient education who bear their own expense are furloughed at the end of one year's service. School teachers, clergymen, apothecaries and medical students and certain others enjoy reductions of service.

Members of the annual contingents in excess of the number required for training with the colors in peace time are placed in the Ersatz reserve, from which are drawn the first reserves necessary on mobilization.

Officers and Non-Commissioned Officers. — The officers of the German army enjoy a distinguished social position, though not forming a special social caste, and are drawn from the higher grades of society, that is the nobility, sons of officers, officials, owners of estates, etc. The corps of officers is recruited in two ways (1) through volunteers now called Fahnenjunker, who join the ranks with a view of obtaining commissions and (2) through assignment of cadets from preparatory schools. All officers before being commissioned as second lieutenants of a regiment must be accepted by a vote of the officers of that regiment. Officers of reserve are recruited from former one-year volunteers or from retired officers. Officers of the Landwehr are taken from officers of the reserves, from officers who have left the standing army and from one-year volunteers and non-commissioned officers who on discharge are recommended for these positions. Officers at disposal may be recalled to active service on mobilization. The officers of the German army are divided into grades as follows:

(1) Generals, including field marshals, colonel-generals, generals of infantry, cavalry or artillery, lieutenant-generals and major-generals.

(2) Field officers: Colonels, lieutenant-colonels and majors.

(3) Captains, first and second class.

(4) Subalterns: First lieutenants and second lieutenants.

The non-commissioned officers are divided into two general classes. The first class are quasi-officers, wear officers' swords and correspond to our non-commissioned officers of the staff corps, first sergeants and quartermaster sergeants and include candidates for a commission (Fähnriche).

The second class correspond to our sergeants, corporals and lance corporals (Gefreite).

Numbers Available.— The peace strength (1900) was as follows: Officers, 23,844; non-commissioned officers, 80,556; privates, lance corporals, etc., 495,500; volunteers (one year service), 9,000; total 608,900.

In 1913 this total was 620,000 and at the beginning of 1914, 810,000. The total number of trained men available (excluding Landsturm) is over 3,000,000. The number of men in the Ersatz Reserve and Landsturm is about 4,800,000, of whom 800,000 have been trained.

Men of the Reserve and Landwehr are called out from time to time for brief periods of training in accordance with the orders of the emperor.

In time of war the army is divided into (1) field troops, (2) field reserve troops, (3) Landwehr troops, (4) Depot troops and (5) Landsturm troops.

The field troops consist of the standing army filled up by the reserves, the field reserve troops consist of the first levy of the Landwehr to which some officers and men are assigned from the active army. The Landwehr troops are formed from the second levy of the Landwehr and they usually serve on the line of the communications. Depot troops are formed from the Ersatz Reserve and recruits. The Landsturm is for home defense and is called out by Imperial proclamation when required.

Organization.— The troops of the German army in times of peace (1909) are as follows:

These are combined into army corps, which are assigned to territorial district with headquarters, as follows:

Guard Corps, Berlin:

I. East Prussia, Königsberg.
II. Pomerania, Stettin.
III. Brandenberg, Berlin.
IV. Prussian Saxony, Magdeburg.
V. Lower Silesia, Posen.
VI. Silesia, Breslau.
VII. Westphalia, Münster.
VIII. Rhineland, Coblenz.
IX. Schleswig-Holstein and Mecklenburg, Altona.
X. Hanover, Oldenburg, Brunswick, etc., Hanover.
XI. Thuringia and Nassau, Cassel.
XII. Saxony, Dresden.
XIII. Württemberg, Stuttgart.
XIV. Baden, Karlsruhe.
XV. Alsace, Strassburg.
XVI. Lorraine, Metz.
XVII. West Prussia, Dantzig.
XVIII. Hesse-Nassau, Frankfort-on-the-Main.
XIX. Saxony, Leipzig.

I. Bavarian, Munich.
II. Bavarian, Würzburg
III. Bavarian, Nürnberg.

The field army is divided into armies, the number and composition of which is kept secret, but in times of war there will be a number of these composed of units of from three to six army corps, several cavalry divisions and a variable number of reserve divisions.

ORGANIZATION	Officers	Non-commissioned officers and privates	Horses	Horse batteries
Infantry, 216 regiments	12,448	371,350	......	.....
Sharpshooters, 18 battalions	406	11,051	......	.....
Machine gunners, 16 sections	64	1,412	864	96
Cavalry, 101 regiments	2,533	68,896	68,506	.....
Field artillery, 94 regiments	3,064	64,944	36,158	3,030
Foot artillery, 18 regiments	1,008	25,584	1,258	.....
Pioneers, 29 battalions, 1 company	679	17,179	......	.....
Railway troops, 7 battalions	179	4,394	......	.....
Telegraph troops, 4 battalions and 2 companies	104	2,180	208	.....
Aviation, 1 battalion, 1 section	22	407	59	.....
Experimental section	32	140	......	.....
Traffic officers	3	7	......	.....
Transport troops, 23 battalions, 7 sections	351	7,797	5,236	.....
Recruiting bureaus, 303	904	6,227	......	.....
Special formation (colleges, half-invalids, guards, etc.)	609	1,654	......	.....
Non-garrisoned officers	3,154	1,396	......	.....
Total	25,560	*584,636	112,289	3,126

* 0.92 per cent of total population, 1909 (63,554,700). With a population of 67,700,000, the army was increased in the spring of 1914 to a grand total of 810,000, thus 0.83 per cent of the total population serving in the army.

The strength of units varies both in officers and men; those on the frontiers having a somewhat higher peace establishment than the normal given below.

INFANTRY UNITS	Peace				War					
	Officers	Medical officers and officials	Enlisted men	Horses	Officers	Medical officers and officials	Enlisted men	Non-combatants	Horses	Wagons
Company	4	....	142	1	5	....	250	5	8	3
Battalion	18	3	570	7	22	4	1,002	29	46	15
Regiment	57	12	1,768	28	68	12	3,017	93	149	46
Brigade	116	24	3,536	64	138	24	6,037	193	312	93
CAVALRY UNITS										
Squadron	5	...	135	144	5	...	150	11	175	3
Regiment	25	12	687	667	22	...	602	61	741	17
Brigade	...	...	...	...	48	18	1,206	135	1,496	35

There are 11 guard, 155 Prussian, 16 Saxon, 10 Württemberg and 24 Bavarian infantry regiments. There are also 18 battalions of rifles (sharpshooters) which in strength and organization closely resemble infantry.

Cavalry regiments have five squadrons in peace and only four in war, one being left as a depot. They are classified as follows:

Prussia: (73 regiments).— Ten cuirassiers (2 of the guard); 26 dragoons (2 of the guard); 18 hussars (1 of the guard); 19 lancers (3 of the guard); 5 squadrons Jäger zu Pferde. (Mounted sharpshooters).

Saxony: (6 regiments).—Two heavy cavalry (1 of the guard; 2 hussars, 2 lancers, 1 squadron Jägers zu Pferde.

Württemberg: (4 regiments).— Two dragoons; 2 lancers.

Bavarian: (10 regiments).— Two heavy cavalry; 2 lancers; 6 light horse.

Field Artillery: Consists of 42 horse batteries and 532 field batteries.

WAR STRENGTH	Officers	Men	Horses	Guns	Caissons	Store wagons	Provision wagons	Forage wagons
Horse batteries (42), each	5	157	218	6	6	2	1	1
Field batteries (532), each	5	162	132	6	6	2	1	1

Two or three batteries form a battalion, two or three battalions a regiment and two regiments a brigade.

Foot Artillery.— There are 149 batteries of foot artillery organized into battalions and regiments. War strength of battery, 4 officers, 209 men. Armament, various calibres of siege, position and coast defense artillery.

Technical Troops — Pioneers.— Each army corps has a battalion of pioneers (4 companies); three of the corps have two battalions each. Each company has 4 officers and 154 men in peace, 6 officers and 200 men in war.

Cavalry divisions have pioneer detachments of 1 officer and 30 men.

Railway Troops.—There are seven battalions of railway troops (4 companies each). A company consists of 5 officers and 151 men. In time of war the companies are expanded into construction companies, operating companies and companies of laborers.

The Train.— In time of peace there are 23 skeleton battalions of the train, one for each army corps. In time of war these are expanded so that each provides transport for 6 provision columns, 7 wagon park columns, 1 field bakery column, 3 bearer companies, 1 horse depot, 1 reserve bakery column and 1 reserve column for line of communications.

Medical Units.— There is one bearer company for each division and an add'tional one for each army corps. Each company has 3 officers, 8 medical officers, 2 officials, 39 men of the train and 210 bearers, nurses, etc., with 46 horses and 13 vehicles.

The Infantry Division.— This unit consists of: The staff of the division; 2 brigades of infantry; 2 or 3 squadrons of cavalry; 1 brigade of field artillery; 1 or 2 companies of pioneers; 1 divisional brigade train; 1 bearer company.

Its fighting strength is 12,000 rifles, 300 to 450 lances and 72 guns.

The Cavalry Division.—As a rule it consists of: The staff of the division; 3 brigades of cavalry; 2 batteries of horse artillery with light ammunition column; 1 pioneer detachment.

Its fighting strength is 3,600 lances, 30 rifles and 12 guns.

The Army Corps.— This unit forms a small army complete in all its parts. It is composed of: The staff of the army corps; 2 infantry divisions; 1 battalion of rifles; 1 telegraph section and the corps trains.

Fighting strength — 25,000 rifles, 900 lances and 144 guns.

Arms and Equipment — Infantry and Pioneers.— Magazine rifle, model 1898, calibre 7.9 mm. Ammunition: 120 cartridges on the person, 72 in the company wagon, a reserve in the ammunition column; total, about 300 rounds per man. Bayonet (*Seitengewehr*) new model.

Equipped for the field each soldier carries a pack (*tornister*) and in its compartments or attached thereto the following articles: 1 shelter tent and three-jointed pole; 1 pair of lace shoes; cleaning, polishing, washing and sewing materials; 1 pair of stockings or foot cloths; 1 handkerchief; 1 shirt; 1 pair of drawers; 1 cap; 1 cooking utensil (of aluminum) with 1 ration; 3 iron rations; 1 handbook; and 1 song book. The soldier also carries a felt-covered canteen of aluminum and a haversack containing 1 helmet cover, 1 knife, 1 fork, 1 spoon and 1 ration of bread (26⅗ ounces) for the journey by rail. The overcoat and shelter tent in a roll surround the pack. The total load, including clothing on the person, arms and ammunition, is 58¾ pounds.

Cavalry.— The weapons of the German cavalry are (1) the lance, which is a hollow steel shaft 10 feet 6 inches long; (2) the cavalry sword or sabre; and (3) the carbine, which is simply a short rifle and uses infantry ammunition. Officers and non-commissioned officers carry sabre and revolver.

Artillery.— The field and horse batteries have the rapid-fire field gun of nickel steel, calibre 7.7 cm. The howitzer batteries have the field howitzer, model 1898, calibre 10.5 cm. Officers and mounted men carry swords and revolvers; men on foot carry sword bayonets and revolvers — in the ammunition columns, carbines and sword bayonets. The foot artillery have guns of various calibres, 3.7 cm. to 21 cm., depending upon whether they belong to siege, fortress or coast-defense artillery. The men are armed with carbine and sword bayonet.

For the record of the German army in the World War, see WAR, EUROPEAN.

Bibliography.—Deutschland, 'Die Herre und Flotten der Gegenwart' (1903); Edmonds, 'Handbook of the German Army' (1900); Lehnert's 'Handbuch für den Truppenführer,' 'Deutschland als Weltmacht' (1911); Koester, 'Secrets of German Progress' (1915).

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Author of 'Secrets of German Progress.'

26. THE GERMAN NAVY. Historical Outline.— The history of the German navy dates back to the 12th century, when the German Emperor Henry VI made important beginnings in the Mediterranean. In 1226 Lubeck was made a free city and developed an oversea trade and a fleet of fighting ships which became the backbone of the powerful league of Hansa cities. In 1487, during the war with France, Emperor Maximilian established an imperial admiralty. In 1570 efforts were made to build up a navy capable of combating the power of the Danes and Swedes but without effective result. In 1675 the Elector Frederick William chartered three frigates and two smaller craft from the Dutch for operations against the Swedes, and the establishment was later increased, but after the death of the Great Elector it fell into decay, although victories had been scored against Spanish fleets.

Frederick the Great revived the maritime policy and engaged the Swedes in 1759 but without decisive results. For over half a century Germany was not represented on the high seas by any force of consequence.

In 1848 a Danish fleet blockaded German ports and inflicted considerable damage. This led to the augmentation of the fleet and the establishment of the navy as an independent unit, previous to 1861 it having been a department of the army administration. At the outbreak of the war against Denmark in 1864 the navy was of but small size, consisting of three corvettes mounting 27 guns, and one of 17, with four first class gunboats mounting three guns, 17 second class mounting two guns and a number of sailing ships with little or no fighting value, while Denmark had 31 steam war vessels and other craft and was aided by Austrian vessels from the Mediterranean. Several victories, however, were scored. During that war vessels were purchased from other countries and one was paid for by popular subscriptions, showing the keen interest of the public in the navy.

By 1870, after the formation of the North German Confederation, the fleet numbered 47 ships with 480 guns, with a personnel of four admirals, five full captains, 19 captains, 33 captain-lieutenants, 101 lieutenants and 3,655 men, besides marine infantry and naval artillery totaling almost 1,000 men more.

During the war with France, 1870–71, the French forces were greatly superior, but for political reasons it did not attack, and only minor engagements took place, one off Havana in which the German gunboat *Meteor* defeated the French despatch boat *Bouvet*. The inconspicuous naval results of the war as compared with the work of the army caused the navy to be neglected by public opinion for many years.

Meanwhile Germany about 1884 had acquired a mass of African and other colonies and had traded with England for Heligoland. In 1887 the old Emperor William I started the Kiel Canal, and in 1888 William II came to the throne. As the grandson of Queen Victoria he had had many opportunities to witness the great sea power of England, and he was subsequently made admiral of the British navy, an honorary office of command never held by any other foreign sovereign.

During the first 10 years of his reign no particular results were achieved by his naval policy and the public remained indifferent, but meanwhile the German oversea commerce developed and the necessity of a navy to match Germany's growing maritime commerce and colonial development became evident. Admiral von Hollman, Minister of Marine from 1890 to 1897, finally resigned in despair, and the emperor appointed a comparatively unknown naval officer to his post, Tirpitz, born in 1849, the son of a judge, who had entered the navy as a cadet and gradually came forward. Von Tirpitz proved the man of the hour. He proceeded in a diplomatic manner to induce the Reichstag to authorize, in 1898, a plan which called for the following program:

BATTLE FLEET.

19 battleships
8 armored coast defense vessels
6 large cruisers
16 small cruisers

FOREIGN SERVICE FLEET — LARGE CRUISERS.

For East Asia	2
For Central and South America	1
Material reserve	3
	6

SMALL CRUISERS.

For East Asia	3
For Central and South America	3[1]
For East Africa	2
For the South Seas	2
Material reserve	4
	14

1 Station ship

A highly important principle was adopted at the same time, that of making the program extend over a period of years, so that no change would take place in the appropriations from year to year, at the will of the legislative branch, without a repeal of the entire naval law. This bound the Reichstag to the program and enabled German shipbuilders to lay their plans ahead for the building of ships and the investment of capital, which could not be risked had the Reichstag continued to change its mind about the size of the fleet from year to year as had previously been the case.

A further important principle was introduced, that of limiting the life of the ships to a definite number of years and providing for the building of a new ship of the same class at the end of that period as a replacement, while the old ship was relegated to minor service. The program for replacements thus provided for a period of 25 years for the capital ships, 20 years for the cruisers and 15 years for the smaller vessels. This replacement period was later considerably reduced.

Another wise provision was developed, of not calling for the building of ships of an exact pattern or tonnage, leaving this to be determined not by the Reichstag which was not technically capable of doing so, but by the naval designers of the department, who were thus not hampered by inexpert opinions of the legislators. This authorization, however, was utilized in making replacements, to substitute much larger and more powerful ships as time went on and naval needs developed, so that in addition to the replacement of obsolete vessels, the power of the navy increased vastly with the repeated legislative struggles which would otherwise have been needed to gain the same ends. Von Tirpitz was thus practically given carte blanche to make the German navy what he thought it ought to be.

The principle of national service had long since been applied to the navy, so that personnel for the manning of the ships as fast as they were constructed was always ready, and at vastly less expense than was the case with such powers as depended upon voluntary enlistments.

The program adopted in 1898 thus finally placed the German navy on the road of progress and invigorated it with the seeds of growth which caused its ultimate remarkable development.

The program of 1898 was projected for seven years, but before it was finally adopted this period was reduced to six years. Hardly, however, was it well started when the Boer War broke out, and the great success which Great Britain obtained in transporting troops and the effectiveness of her navy reacted powerfully on German public opinion, and in 1900 the naval program was more than doubled, a thing von Tirpitz could not have expected in a decade under ordinary circumstances.

Public opinion was enunciated through the Navy League, a widespread organization of a large number of members paying a nominal membership fee, and this, together with the increasing influence of the German press, caused the whole German nation to turn its energies toward the support of the new naval policy.

In a few years, however, a profound change took place in naval architecture, due to the lessons of the Russo-Japanese War, to the invention of telescope sights for large guns and to the development of the submarine.

Previously all nations had been building battleships with many different sized guns capable of rapid fire, on the theory that an immense number of projectiles dropped on opposing vessels would decide an engagement. The Russo-Japanese naval engagements proved that vessels with a few very large guns, sighted with the telescopic sight, could stand at a great distance and destroy the vessels carrying the more numerous smaller guns without suffering any injury. British designers having been aboard the Japanese vessels had first at hand the technical details and proceeded to lay down keels for new vessels of the new sort. American designers also proceeded along the same lines and England launched the first dreadnought, embodying the new principles, 10 Feb. 1906.

This, with the gradual improvement of the submarine in France and America, created an entirely new condition in naval construction, and rendered obsolete for all practical purposes the navies of the entire world.

Germany consequently adopted a new naval program in 1906 and 1908 and embarked in the construction of the dreadnought type of vessel as dictated by the experience of the Russo-Japanese War. This program continued actively in force until 1912 when an additional program was laid out.

The growth of the German navy can be appreciated by a comparison of the capital ships provided for by the various programs, which are as follows:

Act of 1898 — 17 battleships and 8 large cruisers
Act of 1900 — 38 battleships and 14 large cruisers
Act of 1906 — 38 battleships and 20 large cruisers
Act of 1908 — 58 dreadnoughts
Act of 1912 — 61 dreadnoughts

This program had proceeded to the point of development at the outbreak of the Great War, 1914, of:

20 large battleships (dreadnought type)
20 battleships
8 battle cruisers
33 protected cruisers
8 old armored cruisers
8 old protected cruisers
14 gun boats (for service abroad)
120 torpedo boats over 500 tons
60 small torpedo boats used for mine sweepers and school ships and for special purposes.

The program also provided for 72 submarines of which 39 were said to have been built by 1914.

It will thus be seen that the real development of the German navy began only in 1898, and that in its ultra modern aspect it is but the work of a few years since the adoption of the dreadnought type.

A feature that makes it particularly effective, in addition, is the fact that in peace times it is manned up to about 80 per cent of its effective power, while the navies of other countries are maintained at but half or less than half of their effective strength.

Organization.— The German navy is the navy of the German Empire and not of any of its constituent kingdoms or states. Its members take the oath of allegiance to the emperor and it flies the colors of the empire. Article 52 of the constitution of the German Empire states: "The navy of the empire is a unit under the command of the emperor. Its organization and structure is in the hands of the emperor."

Since March 1899 the emperor had himself been in chief command of the navy. The organ that carried out his orders was a naval board presided over by an admiral in the emperor's retinue.

Every ship in foreign service which has special orders from the chief of the admiral staff is independent of the others and is in politico-military matters directly subordinate to the emperor, but otherwise to the station commander of its home port.

The highest in command on land are the naval station commanders of the Baltic (Kiel) and of the North Sea (Wilhelmshaven); the station commanders being admirals.

The immediate subordinates to the station commanders of the Baltic are the first naval inspector, torpedo inspector and inspector of the naval infantry, and to the naval station commander of the North Sea are: the second naval inspector and the inspector of the naval artillery.

The rank of naval inspector corresponds to that of brigade commanders in the army and is filled by a rear-admiral who regulates the service of the sailor and wharf divisions as well as of the reserve divisions.

The inspection of the naval artillery (Wilhelmshaven) is concerned with the development of the ship and coast artillery department as well as of the mine department and is in charge of the following: The artillery brigades: (1) Friedrichsort, (2) Wilhelmshaven, (3) Lehe, (4) Kuxhaven, (5) Heligoland, for the coast defenses and mines, the artillery and mine school ships, the artillery testing ships and commission, the mine testing commission and the naval telegraph school. The inspection of the naval infantry (Kiel), and the first marine corps (Kiel) and the second marine corps (Wilhelmshaven), is under the authority of an inspector equivalent in rank to a major-general.

Only the coast fortifications of the harbor of Kiel, at the Elbe, on Heligoland, at the Weser and on the bay of Jade are assigned to the navy, and manned by the navy naval artillery that also lays the mines and mans the torpedo boat batteries, while the fortifications along the coast of Prussia (Memel, Pillau, Neufahrwasser), and the coast of Pomerania (Swinemünde, Stralsund, Rügen), are not subordinate to the navy, but to the foot artillery of the army.

Personnel.— In 1905 the personnel of the navy consisted of:

1. Admiral of the fleet (gross-admiral), namely, the Kaiser.

2. Twenty-seven flag officers,— five admirals (admirale); six vice-admirals (Vize-admirale); 16 rear-admirals (Kontre-admirale).

3. Five hundred and fourteen staff officers, — 67 captains (Kapitäne zur See); 447 commanders (Fregatten-Kapitäne) and lieutenant-commanders (Korvetten-Kapitäne).

4. Eight hundred and eighty-three senior lieutenants, lieutenants and sub-lieutenants (Kapitän-Leutnants, over eight years' service; Ober-Leutnants zur See, less than eight years' service; Leutnants zur See).

The entire naval personnel in 1905 consisted of 1,832 officers, 208 doctors, 271 paymasters, 1,762 warrant officers, 8,461 petty officers, 27,302 seamen, 1,109 ship-boys; aggregate 2,311 officers and officials, and 38,632 men.

Subsequent, however, to 1905 the personnel was increased, so that by July 1912 it reached a total of 66,000.

Owing to the large number discharged from service in previous years the supply of experienced men is adequate to any possible development of the navy, and their subsequent experience as in the merchant marine, etc.

The officers are drawn from the naval cadets, the latter being selected from young men of approved origin and education. The recruits are taken from sailors, fishermen, sailmakers, ships' stewards, cooks and waiters; also from men employed on rivers and canals, and from non-seafaring people, such as firemen, machinists, painters, etc.

The period of duty is divided into the active period and the furlough period. The active period is for three years; the furlough period is divided as follows:

Reserve	4 years.
Seewehr — corresponding to Landwehr:	
1st levy	5 years.
2d levy	To end of 39th year.
Naval Ersatz (supernumeraries) men of seafaring or quasi-seafaring population	12 years.

In extraordinary cases use is made of the Landsturm — same as in the army — all seafaring and river people not in the navy; first levy, 17th to 39th year; second levy, 39th to 45th year.

For the record of German navy in the World War, see WAR, EUROPEAN.

Bibliography.— Ferber, 'Organization and Dienstbetrieb der Kaiserlichen Marine'; Brassey, 'The Naval Annual'; Jane, 'Fighting Ships'; 'Deutschland als Weltmacht' (1911); Hurd and Castle, 'German Sea-Power' (1913); Koester, 'Secrets of German Progress' (1915).

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27. GERMANY AND THE WAR. When the German Empire was created in 1871, it straightway became a factor in the attractions and repulsions historically existent among the ruling powers of Europe and making themselves felt not only in Europe but over practically the whole earth. Since the German Empire carried a pushing and expanding personality into an established group, the members of which, in spite of their riper years, showed no abatement of watchfulness and vigor, an international situation was created which, amidst bewildering shifts of relation and numerous diplomatic incidents bearing witness to the constantly growing competition of the governments, carried Europe along with ever increasing momentum until its statesmen lost control of its fate and stood helplessly by while it plunged into the cataract of the Great War. Only a rehearsal of the story evaluing the main elements of conflict can at all make clear how the catastrophe occurred. First, to recall the situation created by the Franco-German War: the acquisition of Alsace-Lorraine by Germany gave her a permanently embittered neighbor on the west. German public opinion had insisted on the cession of the two provinces on the ground that they had been originally German and were appropriated by France in victorious wars. France for her part considered herself the victim of an unjustifiable violence and nursed a sentiment of revenge which dug an unbridgable chasm between the two countries. Bismarck, eager above all to safeguard the empire which he had founded, entered into various diplomatic agreements, all of which looked to making Germany secure and which culminated in 1883 in the Triple Alliance of Germany, Austria and Italy. Its purpose, so far as Germany was concerned, was to isolate and checkmate France, and this purpose may be said to have been fully achieved until, beginning with the year 1890, France drew close to Russia and gradually perfected, as a diplomatic counterweight to the Triple Alliance, the Dual Alliance between Russia and herself. Meanwhile Germany had begun to take increasing part in a movement which has given her the place she holds in the modern political world. The movement has been called by various names and may as well be called imperialism, if it is understood that imperialism means the expansion of life which has been effected by modern science, trade and industry, and which has gradually gained dominance among all those nations endowed with the energy and elasticity necessary to bring about a social, economic and political adjustment to the new world forces. Imperialism aims to carry the products of the home industries, cheapened and multiplied by the factory system, to the markets of the world; it is ambitious to plant its flag over unoccupied or backward regions in order to rule or settle them as dependent colonies; it is keenly on the lookout for raw products for profitable investments, for it is identified with the capitalist classes which are everywhere the real agents of imperialism and reap, if not the exclusive, at least the chief benefits from an expansion policy.

European imperialism is an ancient movement and has only gradually assumed its present developed and intensive character. It was an early, youthful imperialism which in the days following the discovery of America drove Spain, France and England out upon the highways of the sea to seek the fabled wealth of the Indies and to appropriate, much in the spirit of careless adventure, whatever lands they found. In the long conflicts for mastery which followed, England ended by gaining a decisive victory, giving her control of the seas and a colonial empire on which the sun never sets. By the middle of the 19th century only two other countries counted in the colonial world at all, France and Russia, but each in only a limited sphere determined by physical proximity. France reached an arm across the Mediterranean to northern Africa and Russia pushed her huge bulk clear across northern Asia to the Pacific. On the wide ocean spaces, controlled by the British navy and dotted with innumerable British areas, France and Russia had little to say, for they had no means at their disposal for challenging British ascendancy. Nevertheless they nursed imperialist ambitions and would have to be given respectful consideration in any further distribution of the earth's lands and markets. In this connection the fact must be kept in mind that while the colonial movement had, in the 18th century, been brought to a certain conclusion by the settlement of the Americas and the victory of England in India, the appropriation of the tropical regions of Africa and the command of the markets of such backward countries as Persia and China still awaited a decision. It was not till the last two or three decades of the 19th century that the industrial organization of Europe advanced to the degree required for broadening these further issues. Therewith the world embarked on the newest and latest phase of imperialism of which the living generation of men has been the witness. The late birth of the German Empire made it impossible for Germany to enter any but this last stage of the imperialist development and for a while it was doubtful whether, because of the heavy handicap of the delayed start, the German government cared to enter the race at all. Bismarck, the foreign minister, possessed, as was natural enough, a prevailingly continental outlook, and only in the '80s, and then very reluctantly, yielded to the pressure of the merchant classes of Germany to enter the colonial field. The partition of tropical Africa was the question of the day and Germany registered a claim to the general booty just in time to secure consideration. She acquired Togo, Kamerun, and German Southwest Africa on the west coast and the province of German East Africa on the east coast. For good measure, as it were, she was at the same time acknowledged mistress of certain island groups in the neighborhood of Australia, particularly of a large section of unexplored New Guinea. These gains were made possible only by the goodwill of Great Britain, which from its high eminence welcomed rather than otherwise the appearance of Germany among the colonial powers. Renewed friction had recently developed between Great Britain and her older rivals, France and Russia, and under the circumstances the British government naturally enough inclined to the opinion that Germany, favored by Great Britain and colonially harmless, might prove a valuable support. The Anglo-German treaty of 1890 regarding Africa is the documentary witness of this English attitude. The world spoke of an Anglo-German honeymoon, though not for long, since the next decade quickly dissipated every vestige of goodwill between the two Northern powers. The '90s were characterized by a surprising development of Germany in industry and commerce which awakened in her capitalists the hope and resolve of invading every profitable market of the world. Carefully considered, this domestic development was at the bottom of the colonial movement which, as we have seen, had put forth its first feelers in the '80s and which in Germany as everywhere proved to be the unfailing concomitant of business expansion. The business men of Great Britain, already comfortably ensconced in the centres of trade of every continent, began to feel the ever growing competition. The British government, more deliberate than its traders, ignored the situation until a new German sovereign, William II, the grandson of Queen Victoria, who had come to the throne in 1888, not only identified himself with the imperialist policy but seized every occasion, in season and out of season, to proclaim his intention to carry Germany into the realm of world politics monopolized hitherto by Great Britain, France and Russia. It meant not the belated and opportunist imperialism of Bismarck but a set program steadily pursued. While the emperor's forceful language — and it was often offensively forceful — might be discounted and ridiculed as music of the future, the eloquence of the bare figures of the German exports and imports and the growth of German merchant tonnage could not be gainsaid nor the conclusion controverted that they formed a very genuine basis for a German *Weltpolitik*. The "Haves" are never distinguished by much goodwill for the "Have-nots," and it is not to be wondered at that neither London, Paris nor Petrograd appreciated the assertive attitude of the German newcomer. But when all is said, Great Britain was the power particularly affected, for it was she and not France or Russia who boasted a world trade based on ocean routes and who was most acutely exposed to the German competition. While Great Britain was still deeply pondering the German commercial phenomenon, Germany embarked also upon a naval policy. Every country with trade and bottoms desires to protect its floating interests and colonies, and that Germany should, toward the end of the 19th century, have begun the building of a navy was but to fall in line with established precedent. For England, however, it signified the confirmation of her mounting suspicion that the lusty power across the North Sea was a dangerous rival and that in supporting the German colonial cause in its earliest stage she had reared a serpent. The German navy which, once undertaken, grew rapidly, lent weight to German diplomatic action and was, at least by the patriot section of British public opinion, regarded as nothing less than a challenge of the English sea and world supremacy. Concerning the maintenance at any cost of their great position, won by a score of famous wars and a thousand unremembered little heroisms, all Britain was practically unanimous. Early in the 20th century the rift, long apparent, had widened to a chasm and the two countries were threatened with permanent estrangement. True, earnest efforts at reconciliation on the part of notable groups of intellectuals, merchants and workingmen were not lacking, and these efforts were heartily endorsed by the liberal section of the press, but every fresh diplomatic encounter blew the latent national excitement into new flame and invalidated the efforts of the well-disposed. Thus, in spite of the courageous flutings of peace societies, trade and naval rivalry continued to sow their insidious poison; but since issues of trade affect a limited upper group, whereas the navy, visible symbol of pride and prestige, appeals to the whole nation, the naval issue was pushed more and more, and with waxing resentment, into the foreground of discussion. By steadily enlarging their own naval program the British easily maintained their traditional ascendancy. This had long since crystallized into the doctrine of the two-power standard, by virtue of which Great Britain aimed at a tonnage in first-class battleships as great as that of any two possible enemies combined. After a decade of feverish competition, in which all the powers joined, each with a naval program of its own, Britain made a remarkable effort to call a halt: she made overtures to Germany proposing a limitation of armaments on the basis of the existing British superiority. The German viewpoint was stated by Chancellor Buelow in the Reichstag (24 March 1908): «We do not dispute England's right to draw up her naval program in accordance with the standard which its responsible statesmen consider necessary for the maintenance of British world supremacy, and similarly it can not be taken amiss that we should build those ships which we require.» The answer of the British naval secretary, Mr. Churchill, to the effect that the German navy was «a luxury» showed how irreconcilable the two government attitudes had become. The rock-bottom facts, determinative alike of policy and sentiment, were that Great Britain was an overwhelmingly industrial nation depending on food imports made secure by a navy, while Germany, rapidly becoming industrialized, required increasing food imports and, for purposes of insurance, the protection of an efficient fleet. The food shortage in both England and Germany was the inevitable result of the modern industrial development and of the imperialism brought in its train; imperialism, involving national prestige and provocative of passion, in its turn led to an exasperated state of mind which was only too likely on some sudden occasion to release an explosion. Early in the 20th century the British government, which throughout the previous century had acted on the assumption that its potential enemies were France and Russia, definitely saw Germany in this sinister light and accordingly resolved to court the friendship of its older rivals and bring the outstanding disputes with them to a settlement. The Anglo-French treaty of 1904 inaugurated the change and was followed in 1907 by a treaty with Russia. By the treaty of 1904 France, in return for leaving England in undisturbed possession of Egypt, acquired a lien on the vast territory of Morocco, while the Anglo-Russian agreement practically partitioned Persia between the two signatories. It should be kept in mind that Morocco and Persia were two wholly independent Mohammedan states. The criticism occasioned by this procedure in certain English Liberal circles was drowned in the chorus of satisfaction elicited by the drawing together of Great Britain and her former foes. The treaties meant not an alliance but an understanding, which might the more easily ripen into an alliance since France and Russia were already bound by the firmest mutual ties. The new alignment came to be known as the Triple Entente, under which firm-name the three associates henceforth presented a solid front against the Triple Alliance of Germany, Austria and Italy. It goes without saying that the division of Europe into two hostile, all-inclusive camps greatly reduced the possibilities of mediation in future disputes. While the formation of the Triple Entente signified a general reduction of German influence in Europe, the really important feature for Germany was the disposal of such immense territories as Morocco and Persia without her being called into consultation. For here was the capital issue of the age, the issue of imperialism. The distribution of lands, unoccupied and backward, and the conquest of markets capable of absorbing manufactured goods had been proceeding apace, and Germany, though a latecomer, had won a place at the board which she was resolved to maintain. That Great Britain, France and Russia, on the ground of prior claims, should, as it were, form a Colonial Trust and crowd her from the table she was not minded to allow. Her leaders with the instinct of men involved in a struggle for power saw clearly that if they submitted without protest in the crucial cases of Morocco and Persia, they would permit a precedent to be established that would work automatically to eliminate Germany from all other world issues and reduce her to the status of a purely European power. But for better or worse she had developed the will to be a world-power, exactly like the members of the Triple Entente, and firmly asserted her right to «a place in the sun.» In the name of the imperialism, at whose shrine she worshiped like the rest, she claimed the privilege to share in the distribution of all remaining opportunities throughout the world for colonial and capitalist enterprise. This general position the German government announced on the very morrow of the Morocco agreement and frequently repeated its warning during the following months. On 28 Nov. 1905, for instance, it made this statement in the Reichstag: «The difficulties which have arisen between us and France in the Morocco question have had no other origin than an inclination to settle without our co-operation affairs in which the German Empire also had interests to maintain.» But though Germany had what she considered a grievance, she was confronted with an accomplished fact and the question was what practical steps were open for her to take in order to win consideration for her views. The Morocco issue was made particularly difficult by the fact that the open and published treaty of 1904 affirmed and emphasized the independence of Morocco. Great Britain and France could therefore profess that they harbored no designs upon that state. In secret treaties, however, to which Spain was a party, Morocco had, with British participation, been partitioned between France and Spain. To be sure, the world, and more particularly, Germany, suspected the existence of a land bargain but in the face of the upright professions of the conspirators could prove nothing. In fact it was not till 1911, that is, till *after* Morocco had been gobbled up, that the secret treaties were revealed. Germany waited a year after the Anglo-French treaty of 1904 had been arranged to have matters cleared up, and then in the face of the cloud darkening over Morocco took action which left no doubt as to where she stood.

In the course of a cruise to the Mediterranean the German Emperor cast anchor off Tangier and formally declared (31 March 1905) to representatives of the Sultan who had come to meet him that he considered "the Sultan as an absolutely independent sovereign." Threatened in the execution of their secret design, France and Great Britain took umbrage at this action, and with alarming suddenness Morocco leaped into prominence as the burning issue of European diplomacy. The immediate tension caused by William II's visit to Tangier was indeed relieved by a general congress in Spain, at Algeciras, which was called together to discuss the Morocco question and which wrote the independence of the African sultanate into international law (1906). With quiet tenacity, however, due to the pledged support of Great Britain, and on pretexts of maintaining order such as are the stock-in-trade of all imperialists, France worked her way from point to point into Morocco, and in 1911, by a sudden stroke, occupied Fez, the capital, with 20,000 men. The act signified, in spite of Tangier, in spite of Algeciras, the consummation of the Anglo-French agreement, and if Germany intended to protest before the curtain fell upon the play she would have to be prompt about it. By hurrying the small gunboat *Panther* to Agadir, a Moroccan port on the Atlantic, she took emphatic and spectacular action similar to that of 1905. The sending of the *Panther* proclaimed that for her the status of Morocco was still that of a sovereign power as defined by the Act of Algeciras. Another period of fierce tension, under which the very foundations of Europe cracked and rocked, was at last relieved by an arrangement between the main contestants, France and Germany, whereby Germany accepted French control in Morocco in return for certain French regions in tropical Africa. It was a poor *quid pro quo* from an imperialist standpoint, but the best to be had short of the hazard of war. War Germany was not ready to risk nor really capable of undertaking, in view of the fact that Morocco was a sea-issue in which France would have to the uttermost the backing of England, the unchallenged mistress of the seas. On looking back from the height of 1911 over eight years of crisis connected with Morocco, Europe might well heave a sigh of relief, for a general war, threatened again and again, had been averted by compromise. But over what Europe, had it been wiser than it was, would have remained profoundly anxious was that rancors had been created, so terrible they hardly admitted of appeasement. Henceforth a volcano was stirring underneath the continent which could not be extinguished by any amount of diplomatic hocus-pocus. Compared with the Anglo-French agreement of 1904, the Anglo-Russian treaty of 1907 caused hardly more than a ripple. Both Russia and Germany showed a conciliatory spirit, perhaps because they were genuinely alarmed by the spectacle of war so violently raised by the Moroccan conflict. True, Germany could no more hinder the partition of Persia from being carried out than she had been able to hinder the Morocco partition, but she was successful in persuading Russia to recognize her as an interested power and to concede an exchange of favors. By the Potsdam agreement of 1910 Russia, on being promised undisturbed enjoyment of her Persian sphere, agreed to put no obstacles in the way of Germany's railroad policy in Asia Minor and Mesopotamia. Evidently the relations of Germany with Russia were easier than with the two Western members of the Entente. If the intimacy could be still further developed the whole embittered European situation would show a heartening improvement, since in the light of a series of imperialist concessions the complaint of German statesmen, repeated again and again, that the Triple Entente was forging an iron ring to lock Germany up in Europe and shut her off from the seas and outlying continents, would fall to the ground. The fear of encirclement or *Einkreisung* had become a national nightmare, on the dispersal of which the amicable solution of the imperialist rivalries mainly hinged. The Potsdam agreement contained a gleam of promise which, though destined to be miserably extinguished, needs to be fully understood. The treaty pointed to certain Turkish regions as proper areas for German exploitation and indicated that Turkey, following Morocco and Persia, was the next on the list of backward states to be taken over by the powers for a course of modern rehabilitation. But Turkey, occupying provinces of southeastern Europe as well as of western Asia and straddling the Bosporus and Dardanelles, was an infinitely more complicated issue than Morocco or Persia, and presently developed such inflammable problems, many of which had been smoldering for ages, that one sharp crisis followed another without interruption. The upshot was that the general war repeatedly threatened since 1904 but happily adjourned, came at last via Turkey and the small Balkan states, former dependencies of Turkey and since their liberation engaged in fierce nationalist rivalries among themselves and with their neighbors, Turkey, Austria and Russia. At the time of the Potsdam agreement the German interests in Turkey were already more than a generation old. Beginning on a very modest scale and gradually enlarged through the medium of banks and ship-lines, they were not thrust into the foreground until the hostility of England, becoming settled, made all expansion by the open sea highly problematical and underscored the advantage of a continuous land-route to the East. France and Great Britain boasted commercial houses and lucrative concessions in Constantinople, Smyrna and elsewhere long before Germany put in an appearance, but as they enjoyed openings in many other parts of the world which drew the attention of their business men and absorbed the capital of their financiers, Germany by concentrating on Turkey as soon as its many advantages were manifest, was able to catch up with them. German enterprise turned presently to railroad development in Asia Minor and, just as the century was rounded, made its appearance with the famous Bagdad project. This was a plan to continue the railroad from Constantinople to Konia, already under construction, beyond the Taurus Mountains to Bagdad on the Tigris and finally to the Persian Gulf. When, in 1903, the Sultan granted a German company the necessary *firman*, great rejoicings rang out from German imperialist circles. The British imperialist groups, however, rose as one man to vent a vehement protest. The English Foreign Office, unable to resist the pressure from the business world, threw every possible obstacle in the way of the Bagdad line, thereby confirming the German suspicion of a secret program of encirclement, of which Great Britain was the director. Though the railroad was delayed by this hostility it was by no means abandoned by the Germans, and as each new year added to its mileage and its fame it gave birth to expectations, intelligible enough though often foolishly extravagant, of a German expansion movement into Asia Minor and Mesopotamia which would carry not only German capital and civilization but even German colonists into these desolate regions, once upon a time, under strong rule, the most prosperous of the earth. Intoxicated by this rosy dream, increasing segments of German public opinion consoled themselves for the Morocco and Persian fiascos and for the encirclement apparently effective in the West. The German hand held the Near-East and by this avenue Germany would realize her plan to be a world-power along with France, Russia and Great Britain. German influence at Constantinople, due originally to an economic program, led in the course of time, as economic power in backward states inevitably does, to the exercise of political control. For over a hundred years before the appearance of Germany in the Near-East, that is, through a part of the 18th and the whole of the 19th centuries, Great Britain and Russia had been engaged in a diplomatic duel on the Bosporus with the result that each had alternately swayed the Sultan and his ministers in its interest. From about the time of the Bagdad project the German influence loomed so large that both the older powers found themselves eclipsed. While this was a considerable German triumph from the point of view of a Near-East policy, it would amount to little or nothing if the situation among the small Balkan states, and particularly in Serbia and Bulgaria, became at any time so unfavorable to Germany as to cut the communications with Constantinople. Germany, Austria, Serbia, Bulgaria and Turkey represented the succession of territories which would have to maintain mutual goodwill and harmony if the German economic program in Asia Minor was to meet with success. The Austro-German alliance assured a common policy toward the Balkan Peninsula on the part of Berlin and Vienna, but Serbia and Bulgaria were uncertain quantities and might prefer to play their own hand. While Bulgaria was at least not unfriendly, Serbia, after some hesitation, threw in its lot with Russia and the Entente. Therewith Serbia inevitably became a point where the rival imperial systems into which Europe was divided met in violent collision. The story of recent Serbian policy is inextricably bound up with the complicated tale of Balkan development, to which only the barest reference is possible here. The outstanding fact of the peninsula throughout the last few generations has been the uninterrupted decay of Turkey. The fatal weakness of the Ottoman state was a constant temptation to its small but lusty Christian neighbors, Bulgaria, Serbia and Greece, to plan for their aggrandizement at Turkish expense, and all the great powers, and more particularly Austria and Russia because directly abutting on the peninsula, kept a sharp lookout lest some sudden displacement of forces occur derogatory to their interest. Austria therefore had her own reasons, quite apart from German promptings, to cultivate good relations with her Balkan neighbors. Not to be outdone, the Tsar spread his net at Sofia and Belgrade, and because of racial and religious affiliations with the Serbs and Bulgars, he generally enjoyed a noticeable advantage over his Austrian competitor. Passing in review the Austro-Russian relations since the Treaty of Berlin (1878), it becomes apparent that they have gone through numerous and vehement changes. Periods of fair weather have been followed by foul until, beginning with 1908, a succession of crises was precipitated which ended by producing war — a Balkan war of course, which, however, because of the alignment of the powers into two bitterly opposed groups and their solemn engagements to each other, automatically expanded into a world war of unexampled dimensions. These Balkan events must now engage our attention.

The crisis of 1908 began in July with the so-called Young Turk revolution at Constantinople. While a Liberal movement aiming at internal reform, the revolution was also inspired by a fervid Turk nationalism and planned to cement firmly together all the remaining territories of the Ottoman Empire. Such a movement augured ill for the small Balkan states which had been looking forward to a Turk dissolution and it filled them with vague apprehension; it augured ill also for Austria-Hungary which at the Congress of Berlin had acquired Bosnia and Herzegovina from Turkey but only "to occupy and administer," not in full sovereignty. To be sure, for 30 years Turkey had exercised no shred of authority in the two provinces; however, should the Young Turks take it into their heads to revive an obsolete claim a very awkward situation was certain to result. To forestall trouble, Austria, in October 1908, issued a proclamation which annexed Bosnia and Herzegovina and provoked a loud outcry from the patriotic Young Turks. When Austria stood pat, the uproar in the course of a few weeks subsided and amicable relations were resumed between the two powers. Far more violent and enduring was the outcry in Serbia, which country, though it did not, like Turkey, have a claim in law to the two provinces, looked upon them as destined to be ultimately united to Serbia in fulfilment of the national mission of the Serb state. For some decades prior to 1908 Serbia had been cultivating the view of itself as "the Piedmont of the Balkans," called by fate to gather into one family all the scattered branches of the South Slavs. On Bosnia and Herzegovina, inhabited by Serbs and Croats, it therefore looked, in spite of Austrian occupation, as earmarked for absorption, and was fiercely disappointed by the act of annexation. As little Serbia by itself could do nothing, everything depended on the word of Russia, Serbia's Slav brother and powerful friend. When not only Russia but also France and Britain drew up behind Serbia, Austria called on her ally, Germany, and a very breathless situation followed. It was relieved only on Russia's yielding ground and advising Serbia to accept the annexation and promise Austria to live with her on terms of friendship (March 1909). The crisis passed, but would it not revive? Indeed would it not be sure to revive if Serbia felt emboldened to continue secretly the nationalist propaganda which she had just pledged herself not to pursue, and if, on the occasion of some fresh conflict, Russia undertook to back her little brother to the limit? The following years brought a steady flow of Balkan troubles, keeping the great powers in perpetual excitement and culminating in the war of 1912 of the Balkan allies against Turkey, and in the war of 1913 of the Balkan allies among themselves. In these two struggles Serbia played a prominent part, emerging from them with increased territory which carried her far southward into Macedonia. Not only she but all the related groups of the South Slavs very naturally felt puffed up by her achievements with the result that the agitation over Bosnia was spontaneously revived. Bosnian secret societies sprang into being charged with spreading Serb propaganda; nationalist societies located at Belgrade took it upon themselves to direct the underground movement and to supply money and literature. Agitations of this sort, appealing with particular force to the young, have a way of getting out of hand. On 28 June 1914, a group of youthful Bosnian conspirators took advantage of an official visit which the heir to the Austrian throne, the Archduke Francis Ferdinand, paid to Sarajevo, the Bosnian capital, and assassinated him and his wife as they drove through the streets. Here was the Serb crisis back again and in its most acute form! For the past six years the Balkan peninsula had been in wild ebullition, apparently incapable of finding rest; for the past six years the two groups of European powers had confronted each other with waxing suspicion and waning good temper; for the past six years the Hapsburg monarchy had faced a subtle undermining of its control not only over the Bosnians but over its South Slav subjects generally in Hungary, Croatia and Dalmatia. The murder of the heir-apparent marked a climax and Austria resolved at any cost to end the long and insufferable tension. On 23 July 1914 the Austrian ambassador presented an ultimatum at Belgrade which planned to dig the grave of the nationalist agitation in Bosnia by binding Serbia to sweeping and humiliating guarantees. On the failure of Serbia to meet in full the Viennese demands, Austria on 25 July withdrew her ambassador from Belgrade and three days later, on 28 July, declared war against her little neighbor. In every phase of the terrible crisis which followed the Austrian ultimatum to Serbia Germany stood unwaveringly behind her ally for the reason that she shared in every particular Austria's view of the Serb danger. In German eyes Serbia had become a critical issue, perhaps it is not too much to say *the* issue, from the moment the Serb policy of a South Slav state, created with the aid of Russia on the ruins of Austria-Hungary, defined itself on the Balkan horizon. Such a policy, if crowned with success, meant the blocking of the road to the Near-East. Once again the iron ring drawn by the Entente group rose before Germany's eyes and stiffened her determination to see the neighbor monarchy through a situation which while challenging the integrity of Austria, no less certainly threatened with disaster Germany's cherished Turkish program. During the tense and nerve-racking diplomatic action which attended the Austro-Serb developments Germany pursued successively two objects. First, she used her influence to limit the issue to Austria and Serbia in order to enable Austria to achieve her purpose of putting a definite end to Serbian agitation within the Austrian borders. This action against a little but cantankerous neighbor was to be made palatable to the powers by the pledge given again and again beginning 24 July (Austrian Red Book, Dispatches 18, 26, 32, 38, etc.), that Austria contemplated no territorial changes and no infraction of Serb sovereignty. In this policy aimed at localizing the conflict Germany failed because Russia had gone so far in supporting Serbia that both her honor and interest moved her to interfere, not only diplomatically, which was proper and usual, but also in a military way, which was very dangerous. No sooner was Austria's purpose of punishing Serbia clearly seen than Russia ordered a limited mobilization beginning 25 July. This step intended to convey that Russia positively refused, in spite of the Austrian territorial pledge, to look upon the Austro-Serb conflict as a local issue. When the Russian mobilization had advanced to a certain stage and become a matter of common knowledge, the German government turned its attention to its second object, which was the exorcising of this new danger. It brought to the attention of Mr. Sazonov, the Russian Foreign Minister, that since Austria was mobilizing only against Serbia, the Russian mobilization exposed the Austrian flank and would inevitably occasion an Austrian counter-mobilization; further, that if the Russian mobilization grew in scope and reached the districts adjoining the German border, the German government would have to answer with a general mobilization order and that war would immediately result since Germany could not afford to wait while Russia drew her great masses of troops from the ends of her empire (German White Book, Exhibits 10, 11, 18, 23, 24). In spite of all warnings the Russian government, profoundly moved by the plight of Serbia and encouraged by the full support of France and the partial support of Great Britain, proceeded with its military plans and in the early morning hours of 31 July, took the decisive and fatal step of ordering a general mobilization. When this action was reported at Berlin, the German Chancellor, Bethmann-Hollweg, dispatched an ultimatum to Petrograd, setting Russia a time limit of 12 hours to withdraw her measures. When Russia ignored the request, Germany in the late afternoon of 1 August simultaneously mobilized her forces and declared war against Russia. Owing to the Franco-Russian alliance war between France and Germany was certain to follow the breach between Berlin and Petrograd. Merely to test the situation, the German chancellor on the same fateful day (31 July), which saw the dispatch of the ultimatum to Russia, requested France to declare ithin 18 hours whether in the event of a Russo-German conflict France would remain neutral. When the French Prime Minister answered on 1 August that France would act as her interests demanded, mobilization was ordered also against France and war followed. In the general crash of the edifice of peace the British position was for a short time in doubt. On the evening of 2 August Germany requested at Brussels an unmolested passage for her troops through Belgium, and when this was indignantly refused on the ground of Belgium's neutrality guaranteed by the international act of 1839, Germany on 4 August committed an act of war against Belgium by sending troops across the border. On that same day the German chancellor, in a speech before the Reichstag, freely admitted the illegality of Germany's action but attempted to justify it by reason of military necessity, that is, Germany's military plight due to the simultaneous exposure of her two flanks. The violation of Belgian neutrality and international law on becoming known in Great Britain released a general storm of fury and outraged feeling. The British public was instantaneously converted to a policy of war, and when on 4 August the British government sent to Berlin an ultimatum on the subject of Belgian neutrality which met with rejection, neither Parliament nor people brooked further delay and the declaration of war was issued against Germany on 5 August. That the war, once unchained, became general, drawing a constantly increasing number of nations, both great and small, into its vortex was, in view of the close associations of the modern world, inevitable. That, as the unparalleled struggle developed, every purpose, every interest, every ideal dear to each member of the warring groups should be brought to the front and earnest hopes be voiced for their realization as fit reward for heroic effort was equally natural. A complex of exalted emotions thus caused the original cause of the war to be lost from view, especially among the Entente allies. Overwhelmed by the magnitude of the disaster and revolving plans to make an end of war and of all other human ills by one great cure, their public men and journalists multiplied the objects of the war almost *ad infinitum,* specifying, among others, the safeguarding of the small peoples, the overthrow of Prussian militarism, the democratization of Germany, the ejection of the Turks from Europe, the dissolution of Austria-Hungary, the sanctity of treaties, and a permanent league of peace, all voiced in the rhetoric and set purpose of a generous idealism. For her part Germany underwent a similar change in the public profession of the motives which kept her in the field. She stated again and again that she was fighting a defensive war, but by her actions, as distinct from her words, she made it clear as day that what she understood by defense was the right to figure as an imperialist power, chiefly by keeping open the communications to the southeast, to Constantinople and beyond. It was over competitive imperialism that the war began, and the historian may perhaps without presumption declare that imperialism remains its leading content and that its rival claims must in some way be regulated and harmonized if a workable peace is to succeed the unexampled agony.

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28. DIPLOMATIC RELATIONS OF THE UNITED STATES WITH GERMANY. Although American diplomatic and political relations with Germany did not assume large importance until the end of the last century, comparatively unimportant historical relations were begun a century earlier. American hopes of Prussian sympathy in the Revolution were disappointed. Arthur Lee, who was sent to Berlin as American envoy, failed to secure official recognition, although Prussia maintained a friendly neutrality toward the struggling colonies. Frederick the Great, although he favored the American war of independence because of his resentment against England, refused to open the port of Emden to American privateers and failed to keep his promise (made to Lee) to recognize the United States whenever France did so.

In 1785, the last diplomatic act of Franklin abroad was to negotiate with Prussia a treaty of amity and commerce, providing (for 10 years) for abolition of blockades and privateering and inviolability of private property at sea, provisions which were omitted in the later noteworthy treaty of 1799 (also limited to 10 years), negotiated by John Quincy Adams in substitution of that of 1785 which expired in 1796.

The American treaty of 1827 with the Hansa, and of 1828 with Prussia, contained the new Henry Clay principle of absolute reciprocity of tonnage duties. The Prussian treaty, although differently interpreted by the two governments, remained in force, for matters not governed by subsequent convention, until America was forced into the World War in 1917.

In 1835 Henry Wheaton arrived in Berlin as the first American Minister after Adams. He had instructions to direct his attention to three purposes: to establish commercial relations with the German states, to secure the removal of *droit d'aubaine* and *droit de detraction* (tax on estates of foreigners, and tax on emigration), and (in accord with resolutions of Congress, 1837–38) to secure reduction of duties on tobacco and rice. He negotiated for six years, embarrassed somewhat by the question of the obligations assumed in the "most-favored nation" clause — a question which had first arisen in the interpretation of the Louisiana Treaty with France. In 1838 he appeared before the Zollverein (formed 1834) at Dresden and obtained a reduction on rice. In 1842–43 he attended other sessions but found difficulties because of the American tariff of 1842. He finally obtained a commercial treaty of 1844 on a reciprocal basis, and also an agreement to reduce duties on tobacco and lard and not to impose any duty on unmanufactured cotton. The treaty was rejected by the American Senate by a strictly party vote of 26 to 18 on the ground that the State Department had no right to interfere in regulation of commerce. An extradition treaty of 1845 with Prussia was also rejected, because under it a state was exempted from the necessity of surrendering its own citizens. Meantime, in 1840, Wheaton arranged a treaty with Hanover. The United States always refused to recognize the right of Hanover to impose duties (tolls) at Staade on ships ascending or descending the Elbe. By treaty of 1846 Hanover agreed to levy no higher duties on tonnage or cargoes of American vessels than on vessels of Hanover. This treaty was annulled by the conquest of Hanover and incorporation into Prussia in 1866. In 1861 the United States, like other powers, agreed to pay indemnity to Hanover in consideration of the total abolition of the Staade dues and maintenance of works necessary for free navigation as before. An American treaty of 1845 with Bavaria was ratified with amendments later accepted by Bavaria. Between 1852 and 1857 extradition treaties with various German states were negotiated at Washington. In 1852 Prussia concluded such a treaty for herself and 18 other states of the Germanic confederation.

In the American Civil War Germany was friendly to the American Union. During the war, as a result of increasing German emigration to America after 1840, negotiations were begun on the question of the status in Germany of German emigrants who after naturalization in the United States returned temporarily to the land of their birth, which required an absence of 10 years for expatriation. In accordance with an act of Congress (of 1868) asserting the right of expatriation and for providing for defense of American citizens abroad, George Bancroft, the American Minister at Berlin, pressed, first upon the German states and later on the German Empire, the American principle in regard to international status of naturalized citizens. In 1868 he obtained from the North German Union and other German states a satisfactory treaty acknowledging the right of citizens to transfer their allegiance by an uninterrupted residence of five years, accompanied by naturalization. After the creation of the German Empire, Secretary Fish desired to replace this and other German naturalization treaties by a new treaty with the whole empire, including Alsace-Lorraine, but Bancroft did not think the time auspicious to negotiate a treaty which would relieve emigrating Germans from the rigor of German military laws.

Americans sympathized with the German struggle for liberty and with the achievement of German unity. Many, through dislike of Napoleon III, were strongly pro-German in the Franco-Prussian War, even though the new republic of France was seriously crippled by the heartless indemnity exacted by Germany and by the unnatural transfer of Alsace-Lorraine. In 1872 the German emperor arbitrated the San Juan boundary question, deciding in favor of the United States. A year earlier, the German Minister at Washington confidentially sounded Secretary Fish on how the United States would regard a proposed joint concerted movement of European powers to urge on Venezuela a more orderly government and better observance of her engagements. Secretary Fish replied that the answer would depend on Germany's complaint, the precise object and means proposed and the limit of operations, but that he hoped joint intervention could be avoided. In 1875 the American government included Germany in the list of powers whom it invited to join in mediation between Spain and Cuba.

In the last quarter of the 19th century the chief subjects of correspondence in American diplomatic relations with the German Empire were: relations of Church and State (1871–76); German emigration to the United States (including emigration of convicts); expulsion of American emigration agents (1873 to 1897); liability of naturalized American citizens (of German birth) for military service in Germany in case of return to Germany (and arrests or fines incident thereto); American students in Germany; attitude of Germany on the Eastern question (in 1878); German alliance with Austria-Hungary (in 1879); German agitation for colonial expansion (especially in Africa) after 1883; German policy in Samoa after 1884; German annexation of islands in the Pacific (in 1886–87); difficulties of Germany with Spain over the possession of the Carolines (in 1886); bimetallism (in 1895); trichinosis (in 1887–88); German restriction and prohibition on American pork (in 1882–97), and on American cattle (1890–96); and the tariff (especially in 1897).

Relations after 1880 were affected by German commercial restrictions. In the latter part of the decade before 1880 new industrial conditions tended to change early German-American commercial relationship. These resulted in the German agrarian protection policy inaugurated in 1879, made more stringent in 1881 and intensified by acts of 1885 and 1887, culminating in 1890 with the resignation of Bismarck. Much friction resulted from a series of German imperial executive measures restricting American imports, beginning with the regulation of the import of American cattle in 1879 and the restriction on the import of American swine or pork products in 1881. The most important of these decrees was the prohibition in 1883 of the import of American pork, which after long and energetic action of American diplomats was finally removed by the "Saratoga Convention" of 1891 — Germany agreeing to accept American pork inspected under law of March 1891, and the United States guaranteeing to Germany free sugar as provided by the McKinley tariff bill. In 1894 a new decree prohibited the import of live cattle from the United States.

Under a reciprocity treaty negotiated in 1891, Germany agreed to admit at lower duties all American food products and many American manufactures, and for this concession the United States agreed to admit German beet sugar into American ports free of duty. The later American tariffs of 1894 and 1897 precipitated new questions of diplomatic discussion. Under the Dingley tariff, the President, with power to apply by proclamation varying fixed maximum and minimum rates, was able to prevent retaliatory and discriminating tariffs, and in 1900 secured from Germany favorable treatment for American merchants. Although, under Caprivi, the German government in 1891 adopted a more liberal commercial policy, in 1901 it increased duties on many agricultural products and manufactures, and after 1903 inaugurated a new tariff law standing for higher protection all along the line. Efforts were made to utilize German-African colonies as an aid to freeing German cotton industries from the uncertainties of the American cotton market.

Incident to the discussion regarding trade and tariff were several other conditions giving rise to misunderstandings and confusion in German-American relations. Germany regarded the Prussian treaty of 1828 as applicable to the whole empire, although the Bancroft treaties did not apply to Alsace-Lorraine. She also disagreed with the United States in the interpretation of the most-favored nation clause and was not entirely satisfied with the extradition treaties whose scope she wished to extend to include additional extraditable crimes.

The decision of Germany, between 1880 and 1890, to become an imperial colonizing power had a large influence on Americo-German relations. Although the German government, contrary to the earlier policy of Bismarck, was led by 1884 to establish colonies in South Africa and East Africa, the American government, influenced by traditional policy, held aloof. Even in accepting an invitation to the Berlin conference regarding the Kongo in October 1884, it did so only with the expressed understanding that it is not American policy to intervene in the affairs of foreign nations to decide territorial questions between them. Although recognizing the International Association of the Kongo, it did not submit the Berlin treaty to the Senate for ratification.

About 1883, just before Germany was admitted to colonial possessions in Africa, German professors began to attack the American Monroe Doctrine. Soon thereafter, Americans, observing the increasing German immigration and business relations in Latin-America — especially in Brazil, Patagonia, Venezuela and Mexico — began to be concerned lest Germany would extend her colonial ambition to South America. In March 1883 the American Minister at Berlin called the attention of the government at Washington to the disposition of the German government to take possession of Patagonia and other South American territories. German hate of the Monroe Doctrine grew in a ratio proportional to the growth of the German navy. Even Bismarck, who claimed to be friendly to the United States, and opposed the inauguration of the German colonial empire, characterized the doctrine as "an international impertinence." In October 1897, Andrew D. White, the American Minister at Berlin, informing his government that Germany was anxious to increase her colonial possessions, stated that efforts were being made to direct German immigration to South America, especially with a view of taking advantage of the anticipated eventual breaking-up of the United States of Brazil, and therefore that Germany was opposed to any international recognition of the Monroe Doctrine and displeased with any reiteration of the doctrine by the American government.

Although, as early as 1871, the German government was reported to have considered the question of the acquisition of Samana, the first actual evidence of territorial rivalry with the United States appeared in the Pacific. The American government — following the German absorption of the northern side of New Guinea in 1884, the dispute between Germany and Spain for the Carolinas in 1885 and the German occupation of other islands by imperial decree in 1886 — decided to maintain rights to which the United States had become entitled in any of the few remaining unappropriated Pacific islands which were under independent and autonomous native governments, and so notified the German government. It was especially determined to preserve Samoan independence.

In Americo-German diplomatic relations, the question of the Samoan Islands attained a prominence disproportionate to its importance. In 1887, American interests and responsibility in the islands, under a treaty of 1878, came in conflict with German intervention. In 1885, the German consul, on pretext of an agreement of 1884 with the native king, precipitated a crisis by raising his flag over the royal hut at Apia and taking possession in the name of his government. In the following year, the American consul, in order to counteract German influence, proceeded to raise the American flag, and proclaimed a protectorate which the American government later disavowed while speaking in a determined tone regarding the protection of American rights in the Pacific. In 1887, a conference at Washington failed to agree upon a plan of adjustment. The real obstacle to agreement was the traditional American belief in the right of self-government. A second crisis was reached when Germany forced King Malietoa to abdicate, imprisoned him on a German war vessel, carried him to Berlin and declared war on Samoa. A new crisis, resulting from rival warships at the islands, was averted by a providential hurricane. Relations were decidedly strained until, by invitation of Bismarck, earlier unsuccessful conferences were resumed at Berlin, resulting in a treaty of 1889 which recognized the independence of the islands under a tripartite, hybrid system of government of the islands under joint protection of the United States, Great Britain and Germany. Ten years later, this cumbersome government was abandoned and terminated by a treaty of 1899 providing for a division of the islands between the United States and Germany, each with jurisdiction in its own territory. Thus, Germany obtained a colony and the United States a coaling station.

At the opening of the Spanish-American War a more serious international situation arose in connection with the appearance and action of the German squadron under Admiral Diedrichs at Manila Bay, which precipitated a controversy with Admiral Dewey of the American fleet. The incident indicated an apparently unfriendly attitude of Germany, and produced strained relations, which but for the attitude of the commander of the British fleet might have degenerated into actual conflict. The report of the affair awakened many Americans to the necessity of larger naval preparation for defense against German designs. The chief factor in determining the American government to decide upon the acquisition of the entire Philippine group was the apprehension that whatever was left would be taken by Germany — an apprehension which was justified by the previous action of the German fleet during the American occupation of Manila harbor, and which was later proven not without foundation by the prompt German purchase of all remaining possessions of Spain in the Pacific (the Carolines and the Ladrones) in 1899.

Relations with Germany became more strained each year after the Spanish-American War, and additional evidence of German greed and jealousy, already shown in the German seizure of Kiau-Chau, appeared in the apparent purpose of Germany to secure the partition of China by the instigation of Russian aggression, and in the severity of German policy following the Boxer uprising in China — all of which were opposed by the United States. Especially after Cleveland's warning relative to the Monroe Doctrine the German government watched for an opportunity to humble the United States while the emperor used various forms of flattery and seduction to establish in America a wide German influence through agents, advocates and promoters of the glory of the Hohenzollern dynasty. Although Germany in 1899 signed The Hague treaty which was to lead the way to disarmament, she proceeded without delay to spend millions in increasing her navy.

The result was to make Americans suspicious of the designs of Germany — especially in relation to interference in Denmark to prevent the ratification of the American-Danish Treaty of 1902 for the transfer of the Danish West Indies, interference in Colombia to prevent the conclusion of a treaty for the construction of the Panama Canal, and initiation of an assault against Venezuela to defy the United States and destroy the Monroe Doctrine which stood in the way of German designs in the Caribbean. Germany's relations with Latin America were especially regarded with watchful suspicions by the United States. In 1900, Senator Lodge, advocating the maintenance of a proper navy, referred to the possible future necessity of protecting the Monroe Doctrine in Brazil, in which country Germany had developed intimate relations through new postal and commercial arrangements.

To allay American suspicion, and remedy the growing alienation between the two countries, the Kaiser, becoming demonstrative in declarations of friendliness, diplomatically initiated attempts at reconciliation by sending his brother on a visit to the United States (professedly on a friendly mission but also to solidify the German-American movement in behalf of the fatherland), and by other acts, including the ill-timed presentation of a statue of Frederick the Great to the United States, and the later arrangement for exchanges of university professors — thus providing a more pleasant atmosphere for negotiations on the question of German restrictions on American trade.

These acts, however, did not make the American government under Roosevelt less alert in scenting danger in the gravity of the events in Venezuela by which Germany sought to test the strength of the Monroe Doctrine. As the isthmian canal project developed into a possible certainty, Germany increased her efforts to obtain a foothold in the western hemisphere, and especially in the vicinity of the canal. In May 1901, Hay had information that Germany contemplated occupation of two islands off the coast of Venezuela as naval base, and later he learned of negotiations for the purchase of two harbors on the coast of lower California. About the same time the more real danger began to develop in Venezuela as a result of a German debt-collecting expedition and "pacific blockade" which sought a pretext for occupation of Venezuelan coast towns. On 11 Dec. 1901, the German Ambassador, in stating to the American government that Germany found it necessary to use coercive measures against Venezuela for satisfaction of claims, gave assurance that his government under no circumstances would consider the acquisition or permanent occupation of Venezuelan territory. Later, when Germany declined to arbitrate the Venezuelan question, Roosevelt firmly applied pressure and took steps which seemed necessary to prevent any occupation of Venezuelan territory, and thus induced the emperor to accept arbitration.

The formal German blockade of the Venezuelan port was terminated in February 1903 by diplomatic intervention of the American government. At the suggestion of President Roosevelt, who declined an invitation to act as arbitrator, the question at issue was submitted to The Hague Court. In connection with the controversy the manly utterances of England's Premier (Balfour) in favor of the Monroe Doctrine were in striking contrast with the melodramatic performance of Germany's Chancellor in the Reichstag to elicit applause of the gallery. British statesmen, dealing with American questions, had long learned that American public opinion is molded by the people, but German statesmen remained ignorant of American democratic conditions.

Although Germany was victorious by the decision in the settlement of the Venezuelan dispute, she received a lesson in regard to American determination to maintain the Monroe Doctrine, against which Pan-Germanists have raged so furiously, and discovered that the American government will oppose encroachments which might result from intervention in American States. President Roosevelt interpreted the Monroe Doctrine so clearly that there was no remaining excuse for misunderstanding. In 1906, at the turning point in German colonial policy, the Kaiser, in dictating that the American government must be invited to the Algeciras Congress to participate in the decision of the question whether Germany should have a foothold in Morocco, sought to embroil the United States in European affairs in a way that would compromise the Monroe Doctrine, but failed in his purpose. Germany felt a keen disappointment in the failure to secure a port at Morocco, which by its nearness to the southeastern coast of South America would have given her a great advantage in trade competition with the United States in that region, and might have served as a valuable outpost in the realization of Pan-German ambition in Brazil where interference would have resulted in an inevitable collision with the United States.

At the second Hague conference, in 1907, Germany led the opposition against the American proposal for a form of treaty to secure obligatory arbitration at The Hague Court for certain cases of international controversy, and induced four other powers (including Austria and Turkey) to vote against it. Explaining this opposition, she said that although not opposed to obligatory arbitration in principle she was not ready to sign such a treaty with all the powers including backward as well as advanced.

Although various international amenities initiated by the German Imperial government brought a decline of American suspicion which had grown from Pan-German clamor, the American government after 1910 was considerably disturbed by a new source of possible conflict with Germany furnished by insurrectionary conditions in Mexico which threatened foreign interests and raised questions concerning the application of the Monroe Doctrine. In March 1914, Senator Fall of New Mexico asked for immediate intervention in Mexico to prevent intervention by Germany.

At the beginning of the World War, which opened with Germany's brutal attack on Belgium in order to seize northern France, the German Ambassador at Washington, without invitation or suggestion from the American government but to calm possible apprehension not felt, submitted a positive denial of any purpose to acquire territory in America in connection with the war; and later Dr. Dernberg, the unofficial representative of the emperor, elaborated the statement to include North America and denied that Germany had the slightest intention of violating any part of the Monroe Doctrine. Significant to Americans, however, was the fact that Germany saw nothing immoral in taking colonies elsewhere belonging to other nations, or in the occupation or possession of small states which have strategic importance.

Later, while the American government still sought to remain neutral, the German government deliberately violated American neutral rights on the seas by a system of piratical warfare, inaugurated negotiations for an alliance with Mexico and Japan against the United States and conducted a secret campaign against American domestic security by fomenting strikes, by hiring criminals to destroy property, by subsidizing a propaganda of disloyalty, by placing spies in government offices, and by other unfriendly acts which forced the United States to enter the war in order to enforce peace and preserve civilization.

Bibliography.— Coolidge, A. C., 'United States as a World Power' (1917); Edginton, T. B., 'The Monroe Doctrine' (1904); Fisk, George M., 'Beziehungen zwischen Deutschland und den Vereinigten Staaten' (1897); Henderson, J. B., 'American Diplomatic Questions' (1901); Latané, J. H., 'America as a World Power' (1901); Moore, J. B., 'Digest of International Law' (1906); Thayer, W. R., 'The Life of John Hay' (1915).

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GERMANY, Emperors and Kings of. Up to the Treaty of Verdun (843 A.D.) we cannot speak of a king or emperor of Germany. Charlemagne was «King of the Franks» and «Emperor of the Romans.» But as he was the first to unite all the elements that later made up Germany, he rightly heads our list.

NAME	Dynasty	Date of Reign
Charles the Great or Charlemagne	Carolingian	768–814
Louis the Pious (emperor)	Carolingian	814–840
Lothair (emperor)	Carolingian	840–843
Louis the German (first real king of Germany)	Carolingian	843–876
Charles III, the Fat (king and emperor)	Carolingian	876–888
Arnulf (king and emperor)	Carolingian (illegitimate)	887–899
Louis the Child	Carolingian (illegitimate)	899–911
Conrad I	Franconian	911–918
Henry I, the Fowler	Saxony	919–936
Otto I the Great	Saxony	936–973
Otto II	Saxony	973–983
Otto III	Saxony	983–1002
Henry II the Holy	Saxony	1002–1024
Conrad II the Salian	Franconian	1024–1039
Henry III	Franconian	1039–1056
Henry IV (whose reign was interrupted by the four following)	Franconian	1056–1106
Rudolph of Swabia	....	1077–1081
Herman of Luxemburg	....	1081–1087
Conrad (son of Henry IV)	....	1093–1098
Henry (son of Henry IV)	....	1105–1106
Henry V (same as above)	Franconian	1106–1125
Lothair the Saxon	Saxony	1125–1137
Conrad III	Hohenstaufen	1138–1152
Frederick I Barbarossa	Hohenstaufen	1152–1190
Henry VI	Hohenstaufen	1190–1197
Philip of Swabia, Otto IV } Jointly	Hohenstaufen	1197–1208
Otto IV (alone)	Guelph	1208–1215
Frederick II (whose reign was interrupted by the following)	Hohenstaufen	1215–1250
Henry (Landgrave of Thuriniga) merely nominal	....	1246–1247
William of Holland (chosen by the ecclesiastical electors) merely nominal	....	1247–1256
Richard, Duke of Cornwall, England, merely nominal	....	1257–1272
Alphonso of Castile, merely nominal*	....	
Rudolph	Hapsburg	1273–1291
Adolphus	Nassau	1292–1298
Albert I of Austria	Hapsburg	1298–1308
Henry VII	Luxemburg	1308–1313
Louis IV } Were contenders.	Bavaria	1314–1347
Frederick the Fair } Were contenders.	Austria	1314–1330
Charles IV	Luxemburg	1347–1378
Gunther, Count of Schwarzburg (rival king)	....	1349
Wencelaus (deposed)	Luxemburg	1378–1410
Rupert, Count Palatine	Bavaria	1400–1410
Sigismund of Brandenburg	Luxemburg	1410–1437
Jobst of Moravia (pretender)	....	1410–1411
Albert II	House of Austria Hapsburg	1437–1439
Frederick III	Hapsburg	1440–1493
Maximilian I	Hapsburg	1493–1519
Charles V	Hapsburg	1520–1556
Ferdinand I	Hapsburg	1556–1564
Maximilian II	Hapsburg	1564–1576
Rudolph II	Hapsburg	1576–1612
Matthias	Hapsburg	1612–1619
Ferdinand II	Hapsburg	1619–1637
Ferdinand III	Hapsburg	1637–1658
Leopold I	Hapsburg	1658–1705
Joseph I	Hapsburg	1705–1711
Charles VI	Hapsburg	1711–1740
Charles VII	Bavaria	1742–1745
Francis I	Hapsb'g-Lorraine	1745–1765
Joseph II	Hapsb'g-Lorraine	1765–1790
Leopold II	Hapsb'g-Lorraine	1790–1792
Francis II	Hapsb'g-Lorraine	1792–1806
William I**	Hohenzollern	1871–1888
Frederick	Hohenzollern	1888
William II	Hohenzollern	1888–1918

* The period from 1250 to 1272 is generally called an interregnum.

** Between the end of the "Holy Roman Empire" (1806) and the beginning of the new German Empire (1871); fall of the German Confederation (1815–1866) and the North German Confederation (1867–1871)

Consult Henderson, 'A Short History of Germany' (2 vols., New York 1902). At the head of each chapter will be found further references.

GERMERSHEIM, gĕr'mĕr-shīm, Germany, town in the Bavarian Palatinate, on the Rhine, 10 miles southwest of Spires. In Roman days it was a station called Vicus Julii and in 1793 it witnessed the victory of the Austrians over the French. It has manufactures of ornamental stonework, blocks for paving, beer and pressed yeast. There is also a large river trade and the fishing is not inconsiderable. Pop. 5,800.

GERMICIDES, agents used to destroy or to hinder the growth of microscopical forms of plant and animal life.

Germicides may be grouped under three general heads, those that act mechanically, those that destroy life by physical means and those whose action is chemical. Inasmuch as each particular germ is an individual with its own particular characters, definite methods for its killing must be devised. Thus it is well known that quinine, for instance, is very active in destroying animal parasites, such as the malarial organism, but it is practically of no service in combating a large number of vegetable forms; and vice-versa, many substances which are capable of destroying plant germs are inefficient when applied to animals.

Of the physical agents, heat, light, cold and electricity, heat is the most satisfactory. High degree of temperature will destroy all forms of parasitic life. The animal forms succumb very readily to the influence of heat, and most of the plant parasites are destroyed by it; but whereas heat may be applied with great success as a germicide in general disinfection, it naturally cannot be used as a general agent on the body. The red-hot iron in the form of a galvanocautery, or a heated wire, makes a most efficient form of cautery to destroy the poison of dog-bite, or to destroy localized forms of tuberculosis, etc., but heat is thus limited in its application.

Cold was formerly regarded as a powerful germicide; but now there is a tendency to emphasize other factors than cold itself as potent. Cold — which kills the bacteria of yellow fever, but not those of smallpox or typhoid — may even act as a preservative of germ life, as is established by the high germicidal content of frozen food stuffs, after months and weeks in cold storage. Recent investigation has led to the conclusion that the degree of cold, time of freezing, crystallization and external pressure, and the composition in which the freezing occurs, all have an influence on the germicidal potency of cold.

Light, especially sunlight, is a very efficient germicide, but the exposure must be continued for an appreciable length of time. Sunlight is nature's great germicide. Within recent years the light given by the Röntgen ray (X-ray), by radium, polonium, thorium and similar agents, has been used with great success in the treatment of certain parasitic skin diseases, but whether the effects are due to any germicidal action of the light, or to a normal tissue stimulation, is not decided. It seems from experiments thus far recorded that these forms of light are not definite germicides. Various colored lights, particularly red and amber, are known to restrict the growth of certain forms of bacteria. They do not, however, destroy them. This principle is made use of in smallpox hospitals and similar institutions, but it does not seem that the results are sufficiently striking to base any general deductions thereon. Electricity is not an efficient germicide. The passage of electrical currents through water does not necessarily kill the bacteria contained therein, notwithstanding the many claims made by enterprising manufacturers of electrified water, said to be made germ-free by the electrical current.

Chemical germicides are numerous, both for external and internal use, although intracellular germicides, or those that can be used within the tissues of the body, are much to be desired. The list of chemical germicides is enormous. Thousands of different agents have been used and these exhibit varying degrees of germicidal activity. As has already been said, each form of germ possesses its own powers of resistance, and each germicide its ability to kill in varying degrees of strength. The germicides in popular use are chlorinated lime, carbolic acid, creosote, alcohol, boracic acid, ammonia, formaldehyde, hydrogen peroxide, iodine and its preparations, mercury and its preparations, volatile oils of cinnamon, mustard, peppermint, turpentine, pennyroyal, oxygen, quinine, salicylic acid and its derivatives. Of these for external use, for use in closets, in bedding, for linen, etc., carbolic acid in the percentage of 1 to 50 of water, formaldehyde in percentage of a teaspoonful of the 40 per cent solution of the gas to a quart, bichloride of mercury in the proportion of one part to 1,000, are the most practical and convenient germicides. So far as is now known, quinine is about the only efficient chemical substance that can be used as an intracellular germicide. It has the singular property of poisoning the malarial parasites within the red blood-cell without poisoning the blood-cell itself, a selective property which most poisonous agents lack.

The great germicide of the human body, and the one that protects it in its various struggles with different forms of parasites, is the blood-serum. This is a very efficient germicide, a full consideration of the action of which will be taken up under the heading of IMMUNITY. Consult Buck, 'Reference Hand-Book of Medical Sciences' (1902), article on *Germicides;* Harrington, 'Practical Hygiene' (1901). See BATERICIDE; BACTERIA; DISINFECTION; GERM; IMMUNITY.

GERMINAL, zhăr'mē'năl', the seventh month of the first French republican calendar, 21 March–19 April.

GERMINATION, in botany, the first act of growth, which takes place in an embryo plant. See SEED.

GERMINIE LACÉRTEUX, zhăr'mē'nē' lā'săr'tè, a romance by Edmond and Jules de Goncourt, published in 1865. It aims to present a so-called «clinic of love» and was dramatized by Edmond. In 1889 it was produced at the Odéon.

GERNSHEIM, gĕrns'hīm, **Friedrich,** German composer: b. Worms, 17 July 1839. He studied at Mainz, Leipzig and Paris, became an instructor in the Conservatory of Cologne in 1865, and in 1873 also kapellmeister of the theatre there. In 1874 he was appointed director of the Rotterdam school of music, and in 1890 of the Stern Choral Union of Berlin. His works include chamber-music, three symphonies and other instrumental compositions; the song-cycle 'Hafis,' for solo, chorus and pianoforte; and various vocal compositions.

GERO, gā'rō, a hero in the 'Nibelungenlied' and a real historic character. He was Margrave of Ostmark and in 939 conquered the Slavic peoples between the Elbe and the Oder.

GÉRÔME, zhā'rōm', **Jean Léon,** French painter and sculptor: b. Vesoul, Haute-Saône, 11 May 1824; d. Paris, 9 Jan. 1904. He was a pupil of Delaroche, who early credited him with originality and style. When he exhibited his 'Fighting Cocks' in 1847, Théophile Gautier wrote in *La Presse,* «Let us mark with white this lucky year, for unto us a painter is born.» He accompanied Delaroche to Italy, 1844–45,

Courtesy of the Booklovers Magazine

JEAN LÉON GÉROME

and visited Russia and Egypt in 1854. He first showed his power in some Egyptian studies, but only reached the level of intensity and vividness which characterized all his succeeding work in his 'Duel after a Masked Ball.' In 1855 he exhibited 'The Age of Augustus,' a picture in which were harmoniously blended marvelous historic faithfulness with a powerful allegory by which the culmination of pagan civilization and its gradual paling in the dawn of Christianity was finely suggested. His grasp of classic motifs was united to an extraordinary mastery of archæological detail, and his Roman 'Gladiators in the Amphitheatre' (1859), and 'Phryne before her Judges' (1861), are startling in the impression which they convey of antique life in its movement, sentiment and passion. In this special department of historical genre Gérôme easily led the European painters of his century. Other of his paintings are 'Two Augurs' (1861); 'Cleopatra and Cæsar' (1866); and 'Pollice Vorso' (1873). Specimens of his work are in the Boston Museum, Metropolitan Museum and the Vanderbilt Collection, New York, and the Walters Gallery, Baltimore. He was elected a member of the Institute in 1865, was chevalier of the Legion of Honor in 1855, and later commander. In later life he devoted himself mainly to sculpture. Consult Claretie, 'Peintres et sculpteurs contemporains' (1884); Cook, 'Art and Artists of Our Time' (1888); biography by Hering (1892); Van Dyke, 'Modern French Masters' (1896).

GERONA, hä-rō'nä, Philippine Islands, town of Tarlac, province of Luzon, 10 miles north of Tarlac, on the Dagupan-Manila Railway. Pop. 14,000.

GERONA, Spain, a city and capital of the province of Gerona, 65 miles from Barcelona. It is celebrated for its churches: the cathedral is the finest specimen of Gothic architecture in Spain, the nave of which is the widest pointed vault in Christendom; the apse of San Pedro is probably of the 10th century, and the church of San Feliu is of the 14th century. In its stormy history the town has undergone 25 sieges, the last, from May to December 1809, being distinguished by a heroic defense against the French (who lost 15,000 men) until disease and famine enforced its surrender. Pop. 17,416. The province of Gerona has an area of 2,264 square miles. Pop. over 300,000.

GERONIMO, jĕ-rŏn'ĭ-mō, Apache chief of the Chiricahua band: b. about 1834; d. Fort Sill, Okla., 17 Feb. 1909. In 1884–86 he became noted as the ring-leader in the harrying of Arizona and New Mexico. (See APACHE). In 1882 he organized a raid into Sonora; in 1884 he instituted a reign of terror in New Mexico and Arizona. General Crook forced him to a stand on 25 March 1886, but Geronimo refused to surrender except for two years, the band to be sent East with their families and then replaced on the old reservation. Crook accepted the terms and started for Fort Bowie, but on the march the entire band slipped away to the mountains and began the old forays again. The subsequent criticism of Crook, as the Indians' dupe against the protests of the settlers, caused his replacement by Gen. Nelson A. Miles, who gave the Indians no rest till Geronimo once more surrendered. General Miles ordered them sent to Saint Augustine, but Geronimo and 14 others were sent to Fort Pickens, Fla., and afterward to Fort Sill, Okla. Consult the 'Story of his Life,' edited by S. N. Barrett (New York 1906).

GÉRONTE, zhā'rŏnt', a type of aged man, found frequently in French classic comedy. The attributes vary in the presentation of the several authors; compare, for instance, Corneille's 'Le Menteur'; Molière's 'Le médecin malgré lui'; 'Les fourberies de Scapin' and Reynard's 'Le joveur' and other comedies.

GERONTES, gĕ-rŏn'tēs, in ancient Greece, a number of magistrates of Sparta who, with the ephors and kings, had the supreme power in the state. They were not eligible for election before they had attained the age of 60 years. Their number is variously stated at 20 and 32.

GEROUSIA, jė-roo'shĭ-ạ, the name of the Senate of Sparta, which was analogous to the Boule of the Athenians. Consult Gilbert, 'Greek Constitutional Antiquities' (London 1895).

GERRESHEIM, gĕr'ĕs-hīm, Prussia, town of the Rhine province and suburb of Düsseldorf. It contains a Romanesque church of the 13th century. Its industrial establishments comprise glass works, rivet and wire factories, silk factories, foundries, etc. In 1909 it was included within the municipal limits of Düsseldorf. Pop. 14,400.

GERRY, gĕr'ĭ, **Elbridge,** American statesman: b. Marblehead, Mass., 17 July 1744; d. Washington, D. C., 23 Nov. 1814. He was a member of the Continental Congress 1776–80 and 1783–85; delegate to the Constitutional Convention in 1789; member of Congress from Massachusetts 1789–93; commissioner to France 1797–98; governor of Massachusetts 1810–12; and Vice-President of the United States 1813–14. It was during his term as governor that an unsatisfactory redistricting of the State took place, in which he was supposed to have taken part, whence arose the term "gerrymander" (q.v.). Consult Austin, 'Life of Elbridge Gerry, with Contemporary Letters' (1828–29).

GERRY, Elbridge Thomas, American lawyer and philanthropist: b. New York, 25 Dec. 1837. He was graduated from Columbia in 1857, was admitted to the bar in 1860, and was a member of the State Constitutional Convention of New York 1867. Subsequently he became an associate of Henry Bergh in the American Society for the Prevention of Cruelty to Animals, of which he was for many years vice-president. In 1874 he was the leading organizer of the Society for the Prevention of Cruelty to Children, of which he was the president in 1876–91, and which became so closely identified with his name as often popularly to be termed the Gerry Society. He was chairman of the commission on capital punishment which substituted execution by electricity for that by hanging, in New York State (1886–88). He also held many important offices of trust, and became known for his interest in yachting affairs, having been commodore of the New York Yacht Club in 1886–93. He is a grandson of Elbridge Gerry (q.v.). With A. F. Currier he wrote 'Corporal Punishment for Certain Forms of Crime' (1895).

GERRYMANDER, gĕr'ĭ-măn-dėr (hard g: now chiefly used as a verb), the arranging of election districts by the party in power in a State when passing a redistribution act so as to concentrate its opponent's majorities and distribute its own, thus giving itself as many with light majorities and its rival as few with heavy ones as possible. Many States are to some extent gerrymandered by nature, the heaviest vote of one party being compacted into a minor section: Indiana and New York are notable cases — the one on account of the southern agricultural population having been kept from expansion by more energetic streams of a different character, the other from the development of a vast city at political odds with the rural parts. Law usually and fairness necessarily provide that the State shall be districted in solid blocks of contiguous territory, so that (subject to the above limitation) the district elections shall correspond roughly to the popular majorities in the State. But since early in the century, all parties in turn have violated political equity by establishing artificial gerrymanders when in power; sometimes creating a popular revolt which has cost them the object of the scheme, but the rival party has rarely learned wisdom from that result, usually reversing the gerrymander for its own profit. As counties are fair models of what election districts should be, the gerrymander is generally worked by disregarding them; but the following illustration of its working with them is the simplest form. Suppose nine counties casting 10,000 votes each, the whole lying in a block thus arranged, and the votes divided between party A and party B as indicated within:

1 A 8750 B 1250	4 A 5250 B 4750	7 A 4850 B 5150
2 A 4500 B 5500	5 A 7500 B 2500	8 A 4750 B 5250
3 A 5100 B 4900	6 A 4300 B 5700	9 A 7000 B 3000

Now let one district be formed from the diagonal counties 1, 5 and 9, and three others, respectively, from 2 and 4, 3 and 6, and 7 and 8. Party A has 52,000 against B's 48,000 altogether or a popular majority of 4,000; but it only carries one district out of four because the gerrymander has made it waste most of its votes and its rival wastes almost none. Yet the law has been observed, as all the counties in each district are contiguous. Of course, in practice such perfect cases do not occur, and towns or counties are grouped raggedly in forms often grotesque. As a political expedient it dates from 1709, when a combination of Pennsylvania's counties sought to deprive Philadelphia of its proper representation.

The origin of the name was probably from the following early case. Massachusetts, in 1812, had its senatorial districts identical with the counties; the State constitution gave the legislature the power of redistricting, however, and the Republicans (corresponding to the Democrats of to-day), carrying the legislature in that year over the Federalists, at once gerrymandered it in a very outrageous fashion. The Boston *Sentinel* published a colored map of one district in Essex County, whose sprawling towns with a huge prong to the northwest seemed like some monstrous animal of fable; and on an indignant Federalist saying that it "looked like a salamander," another retorted, "Better call it Gerrymander," from the Republican governor, Elbridge Gerry (q.v.), whose signature had made it law. Gilbert Stuart (q.v.), the artist, drew a completion of it into an ungainly bird, which figured largely as a campaign document. The Federalists recaptured the legislature the next year and repealed the bill. The most famous of many great gerrymanders in the United States is the "Shoestring District" (Sixth Congressional) of Mississippi, formed to minimize the negro vote, and consisting of all the counties in the State touching the Mississippi River; it is about 300 miles long by an average of 20 broad. (See APPOINTMENT). Consult Griffith, E. C., 'Rise of the Gerrymander' (Chicago 1907); and article by Dean in the 'New England Historical and Genealogical Register' (Vol. XLV, Boston 1892).

GERS, gār, France, a department of the southwest, formerly included in the provinces of Gascony and Guienne. It has an area of 2,428 square miles. It is traversed by the Gers, the Adour Gimone, Bayse and Save. Its surface is largely devoted to grape culture and great quantities of brandy and wine are produced. It is the homeland of the brandy known as Armagnac, second only to that of Cognac. Cereal crops and flax are extensively grown and cattle-raising has attained large proportions. Auch is the capital.

GERSON, zhăr'sôṅ', **Jean Charlier de**, French theologian; b. Gerson, near Rethel, 14 Dec. 1363; d. Lyons, 12 July 1429. His parents were simple peasants of deep piety, who influenced 9 of their 12 children to pursue ecclesiastical careers. At the age of 14, Jean, under the patronage of the Duke of Burgundy, was sent to the College of Navarre. Here he continued his theological studies until 1384, distinguishing himself by his brilliance and diligence in his work. From 1383–84 he served as procurator of the Gallic nation, and in 1387 was sent to Pope Clement VII by the university, as its representative in the dispute concerning the doctrine of Immaculate Conception. In 1395, his teacher, Pierre d'Ailly, was appointed bishop of Puy, and Gerson was chosen to fill the vacancy thus caused in the chancellorship. His occupancy was marked by the highest zeal and the greatest vigor in reforming the morals and the curriculum of the school of theology. In his letters, particularly his 'De reformatione theologiæ,' are set forth the various reform measures which he proposed, as well as his standpoint in theological matters. Gerson avoided rationalism by accepting a form of intellectual mysticism. Subjective intimate contemplation was the means by which the religious mind might arrive at deep insight into the truth and necessity of the dogmas of the Church and morality.

In the schism which followed the death of Gregory XI in 1378, Gerson took an active part in urging its conclusion. As a result of his unceasing efforts, a council was finally assembled at Pisa and Alexander V was chosen

Pope. But the much-hoped for reforms were not instituted, and the death of Alexander resulted only in the election of an inferior ruler, John XXIII. In the meantime political influences began to predominate. Gerson had always been an adherent of the house of Burgundy, while Pierre d'Ailly had remained faithful to the house of Orléans. In 1407, the Duke of Orléans, brother of the king, was murdered by Jean sans Peur, Duke of Burgundy. Jean Petit, a theologian to whom Gerson was hostile, defended the assassination in a stirring address which won the acclamation of many people. Gerson, contrary to the sympathies of the university, openly denounced the act with equal vigor. He then undertook intense literary activity in behalf of his convictions on this subject, as well as on ecclesiastical reform and the healing of the schism, urging the assembling of a council to decide the issues involved. Finally the Council of Constance (1414–18) was convened. Here Gerson's influence reached its climax. The council refused to oppose the Duke of Burgundy, made allowances for Petit and accomplished nothing further. Thereafter, Gerson's prestige vanished altogether, Unsettled national conditions made his return to the university inadvisable, and he sought refuge at Tirol, where Albert of Bavaria offered him protection. He busied himself with an elaborate and vigorous 'Apology,' and wrote four books of 'De Consolatione Theologiæ' in imitation of the work of Boethius. After a short sojourn at Venice, he returned to France and entered the convent of the Célestins where his brother was prior. His last years were spent in conducting a school for children at Lyons, and in literary work. To him was attributed the work on 'Imitation de Jésus-Christ,' which was later assigned more correctly to Thomas à Kempis. The first edition of Gerson's works appeared at Cologne in 1483; the best was published by L. Ellies Du Pin (5 vols., Antwerp 1706). Consult Hundeshagen, 'Die mystische Theologie Gersons' (Leipzig 1834); Schmidt, C., 'Essai sur Jean Gerson, chancelier de l'Université de Paris' (Strassburg 1839); Schwab, J. B., 'Johann Gerson' (Würzburg 1858); Tschakert, P., 'Peter von Ailli' (Gotha 1877), and Jodart, 'Jean de Gerson' (Paris 1881).

GERSTER, gär'stĕr, **Etelka** (MADAME GARDINI), Hungarian singer: b. Kaschau, Hungary, 16 June 1857. She was a pupil of Madame Marchesi in Vienna, and made her first appearance in Venice in 1876, as Gilda, in 'Rigoletto.' In 1878 and also in 1883 and 1887, she made successful tours in the United States. In 1887 she married her director, Pietra Gardini, and since 1896 has been at the head of a singing school in Berlin.

GERSTLE, Lewis, Californian pioneer: b. Bavaria, 17 Dec. 1824; d. San Francisco, Cal., 17 Nov. 1902. Coming to the United States as a lad, he settled in Louisville, Ky., and joined the fortune-seekers in California in 1850. With Lewis Sloss he subsequently formed the Alaska Commercial Company. Their enterprises by sea and land aided largely in building up California, and Gerstle always displayed a public spirit and faith in the future of the State. He was treasurer of the University of California, and identified with many Jewish and general charities, to all of which he was a generous giver.

GERTRUDE OF WYOMING, a narrative poem by Thomas Campbell, written at Sydenham, in 1809. He chose the Spenserian stanza for his form of verse, and for his theme the devastation by the Indians, in 1778, of the quiet valley of the Wyoming, in Pennsylvania, on the Susquehanna. The poem opens with a description of «Delightful Wyoming,» which Campbell, who had never seen it paints as a terrestrial paradise. The whole style and manner is pseudo-classic and old-fashioned; the treatment vague, unreal and indefinite; but its elegance and finish of style, a certain sweetness and pathos, combined with the subject, has kept the poem alive.

GERVINUS, gĕr-fē'noos, **Georg Gottfried,** German historian: b. Darmstadt, 20 May 1805; d. Heidelberg, 18 March 1871. In 1825 he went to the University of Heidelberg, where the lectures of Schlosser inspired him with a peculiar love of historical studies. In 1831 he visited Italy, where he remained for a year collecting materials for the works he was meditating. His 'Historische Schriften,' published after his return (1833), excited the attention of scholars, and secured him in 1835 an extraordinary professorship in the University of Heidelberg, where he was in 1844 appointed to a professorship. In 1836 he was appointed professor at Göttingen, and in the following year was deprived of his chair and banished for protesting against the suspension of the Hanover constitution. From 1845 he took an active part in the liberal movement in Germany. It was at this period that he wrote his 'Mission der Deutschkatholiken' and 'Die Protestantische Geistlichkeit und die Deutschkatholiken.' In 1847 he founded in Heidelberg the *Deutsche Zeitung,* which advocated a representative system for Germany and a clearly-defined federal constitution. His chief works are 'Geschichte der poetischen National-litteratur der Deutschen' (1835–42), in which he endeavors to show how the development of German poetry is connected in all its phases with the history of the nation and other European countries; 'Shakespeare' (1849–50); 'Geschichte des neunzehnten Jahrhunderts (1855–66). All his works, even his more purely æsthetical ones, such as that on Shakespeare, are more or less colored by his political views and aims. In the last years of his life he zealously endeavored to secure the popularity in Germany of the works of Handel, whom he regarded as the greatest genius in the musical sphere that the world had ever seen. He viewed with dislike the manner in which German unity was achieved under the ægis of Prussia. His 'Autobiography' appeared in 1893.

GERYON, jĕ'rĭ-ŏn, in the mythology of Greece a king of Hesperia, son of Chrysaor and Callirrhoe, a three-headed giant. He possessed numerous and fine herds, which were guarded by the two-headed dog Orthrus and the giant Eurytion. The herds were carried away and Geryon and the two guardians slain as one of the 12 labors of Hercules.

GESELLENVEREINE, Roman Catholic benevolent associations of German origin, called into existence in 1846 by a number of journeymen mechanics under the guidance of Adolf Kolping, a member of the Dominican Order, a philanthropist who had traveled throughout Switzerland, the greater part of Germany and the better part of Austria. In Switzerland Kolping personally established and spread the influence of the Gesellenvereine. And when he died in 1865 there were in existence about 400 such guilds on the continent of Europe. Under his first successor, General-President Schäffer, the total number of such institutions amounted to, in 1901, about 1,086 confederations. In the practice of administration, and to serve other essential functions, the membership of Gesellenvereine was parted into two divisions. A member, so proficient as to be able to follow his calling independently and to teach others, received officially credentials to that effect, and was called a master. The remaining members, persons who could not assume the duties of a teacher, but having merely a diploma to the effect that their apprenticeship had been served, were called, collectively, journeymen. In 1901 the total memberships of the 1,086 existing guilds numbered 80,000 journeymen and 120,000 members holding a master's degree. It was Adolf Kolping himself who set the goal and pointed out the path for the institutions to follow, institutions which in so large a measure owed their origin to him. The purpose of this well-intentioned man was threefold. He aimed: (1) To further the education and promote the well-being of the masses. (2) To furnish them with clean amusements; to entertain them away from vice. (3) To induce all members to become and remain strictly observant Christians and moral citizens.

This threefold goal, if attained, it was reasonably hoped, would ensure to all members of the Gesellenvereine the recognition that genuine citizenship always receives. But besides the religio-moral concerns of these confederations, a fourth feature received greater attention for the first time about 1890. Since 1890 considerable emphasis was given to the activities designed to graduate expert mechanics, merchants and men of business, generally; in short, to the promotion of trades of all kinds. It cannot be gainsaid that these educational measures, as well as, if not in particular, the religio-moral measures of these Gesellenvereine, resulted in very great gains to the man of labor.

These institutions own, perhaps, 400 hospices in which a traveling journeyman can find lodging, maintenance and, if need be, even nursing; and a member (for the masters likewise enjoy these privileges) may have all these till he can find such work as his particular training fits him to do. Besides, those who are employed can find in these hospices, and at an almost nominal price, both board and lodging. These hospices are bound together under the control of a single central office: the officiating General-President having his station fixed at Cologne. The associations of the individual dioceses are under the administration of a diocesan praeses, an officer appointed by the bishop. The total amount of money deposited in savings banks in 1903 by the members of the Gesellenvereine amounted to 2,000,000 marks or nearly $500,000. The number of organizations in existence in 1904 is said to have been 1,500.

Even early in the 19th century the prototypes of these guilds existed in Germany. After one had served as an apprentice a number of years, he was known as a «Geselle.» As such it was customary for one to travel from town to town until he found employment at his peculiar calling. He was often called «Handwerks-Bursche» and in most towns taverns were set aside to accommodate him and his comrade «Gesellen.» Such laboring men were each time they left town obliged to show a certificate, their «Wander-Bursch,» to some one in authority and have it signed.

GESENIUS, gā-zā'ne-oos, **Friedrich Heinrich Wilhelm**, German Orientalist: b. Nordhausen, Saxony, 3 Feb. 1786; d. Halle, 23 Oct. 1842. He studied at Helmstedt and Göttingen, and at Halle in 1810 became extraordinary, in 1841 ordinary, professor of theology. Here he lectured for more than 30 years, broken only by the closing of the university during the War of Liberation (1813–14), and by lengthened visits to France and England in 1820, to England and Holland in 1835. His first great work was his 'Hebrew and Chaldæan Hand Dictionary' (1810–12). His 'Elementary Hebrew' (1813–14), consisting of the 'Hebrew Grammar,' and the 'Hebrew Reader,' has contributed enormously to the knowledge of the Hebrew language, not only in Germany, but through translations also in England and the United States. Later works are his 'Critical History of the Hebrew Language and Literature' (1815); 'On the Origin, Genius and Authority of the Samaritan Pentateuch' (1815); 'A Critical Grammatical System of the Hebrew Language' (1817), and a new translation of and commentary on Isaiah (1820–21). His greatest work is the monumental 'Critical Grammatical System of the Hebrew and Chaldæan Languages in the Old Testament,' of which the first part was published in 1829, but which was completed only in 1858 by Rödiger. Rationalistic in his interpretations, he gave a great impulse to the study of the Semitic languages. Consult Hayne, 'Gesenius, eine Erinnerung für seine Freunde' (1842).

GESHUR, an ancient state of Aramæa, east of the Jordan, probably in the southern part of Jaulan, as it is constituted to-day. Maacah bordered on it in the north. It is mentioned in Deut. iii, 14, Joshua xii, 5, as one of the states bordering on the domain of Og of Bashan. A Geshur is mentioned also in Joshua xiii 2, and 1 Sam xxvii, 8, which seems to have been located in southwest Palestine.

GESNER, Abraham, Canadian geologist: b. Cornwallis, N. S., 2 May 1797; d. Halifax, N. S., 29 April 1864. He studied medicine in London, and returned to Nova Scotia. Later he became interested in scientific research. In 1838 he was appointed to examine the report on the geological resources of the lower provinces of British North America. He discovered how to produce oil suitable for lamps from bituminous shale and cannel coal, and this oil he called 'Kerosene,' which name was afterward given to other illuminating oils. This oil was made and consumed by him in his public lectures at Prince Edward Island in 1846, and subsequently at Halifax, N. S. His patents were afterward sold and the oils were manufactured and sold under the denomination of "kerosene oil." His publications include 'Remarks on the Geology and Mineralogy of Nova Scotia' (1836); 'Reports on the Geological Survey of the Province of New Brunswick' (1836–42); 'New Brunswick, with Notes for Emigrants' (1847); 'Industrial Resources of Nova Scotia' (1849); 'A Practical Treatise on Coal Petroleum and Other Distilled Oils' (1860), etc.

GESNER, Konrad von, Swiss naturalist: b. Zürich, Switzerland, 20 March 1516; d. there, 13 Dec. 1565. In 1537 he was appointed professor of Greek at Lausanne. This chair he exchanged four years later for that of physics and natural history at Zürich. He was an indefatigable writer of books and in the course of his life published no less than 72 works, besides leaving at his death 18 others in progress. His 'Universal Library' (1545) contained the titles of all the books then known in Hebrew, Greek and Latin, unpublished as well as published, with criticisms and summaries of each. His next undertaking was the 'Animal History' (1551–58). The first book treats of viviparous quadrupeds, the second of oviparous animals, the third of birds and the fourth of fishes and aquatic animals. He collected more than 500 plants undescribed by the ancients, and appears to have been the first who made the great step toward a scientific classification of distinguishing genera by the fructification. He also wrote on other branches of science, as medicine and mineralogy, and composed a great number of works dealing with the ancient classics, the 'Mithridates sive de Differentia Linguarum' (1555) being the most notable.

GESSLER, gĕs'lĕr, **Albrecht,** or **Herman,** called also GESSLER VON BRUNECK, legendary Austrian official, in 1300 appointed joint-governor with Berenger von Ladenberg, of the Waldstäden or forest cantons (Schwytz, Unterwalden, and Uri), by Albrecht I of Austria. According to the traditions connected with William Tell (q.v.), his oppressive edicts and wanton cruelty so enraged the inhabitants that a conspiracy was formed against him, and he was shot by Tell in a narrow pass near Küssnacht in 1307.

GESSNER, gĕs'nĕr, **Salomon,** Swiss poet, painter and etcher: b. Zürich, 1 April 1730; d. there, 2 March 1788. In 1758 he published an idyllic pastoral, 'Der Tod Abels.' In 1762 he published, in four volumes, the poems which he had previously given to the world on different occasions. In 1772 he published another volume containing a collection of poems, to which he gave the name of 'Idyllen' (idyls), a name which he had already given to a previously published volume of poems. Their quiet, amiable character pleased many in Germany; and in France, where they were translated by Huber, they were received with enthusiasm, and the author was regarded as a poet of the first rank. From France his fame spread over all Europe. The most popular of his idylls is the 'Death of Abel,' since translated into many foreign languages. His 'Life' by Hottinger was published in 1796, and his 'Correspondence with His Son' in 1801.

GESTA ROMANORUM, gĕs'tạ rō-mā-nō'rŭm, 'Deeds of the Romans,' the title of a collection of short tales, legends, etc., in Latin, very popular in the Middle Ages. The book was probably compiled about the close of the 13th century. The separate tales making up the Gesta are of diverse contents, and belong to different times and countries, the sources from which they are derived being partly classical, partly Oriental and partly western. Whatever may have been the intention of the original compiler, they very soon were adapted to the moralizing tendencies of the time, and moral reflections and allegorical interpretations were added to them, it is said, by a Petrus Bercorius or Pierre Bercaire of Poitou, a Benedictine prior.

GESTATION, the period of development of the fœtus from the time of conception to birth. Even in animals, where only a single insemination is allowed, the length of the gestation cannot always be foretold with exactness. The human fœtus is carried in the uterus about 280 days. For periods of gestation in animals, see BREEDING. See also OBSTETRICS; PREGNANCY.

GETA, jē'tạ, **Septimus,** Roman emperor: b. 189 A.D.; d. 211 A.D. He was the second son of the Emperor Severus, and brother of Caracalla, with whom he was associated in the empire on the death of his father. Caracalla, who envied his virtues and was jealous of his popularity, after having endeavored to effect his death by poison, murdered him, and wounded their mother, who was attempting to save him.

GETHSEMANE, gĕth-sĕm'ạ-nē, or **GETHSEMANI** (*Boustanez-Zeitoun*), an olive garden or orchard to the east of Jerusalem, on the road leading from the brook Kedron to the Mount of Olives. The place has specially sacred associations for Christians, as the traditional site of "Our Lord's Agony in the Garden" (Matt. xxvi, 36–57; Mark xiv, 32–53; Luke xxii, 39–53; John xviii, 1–13). The place is now in possession of the Franciscan Fathers of the Holy Land, who, in 1848, built a wall around it the better to protect it. There are eight very ancient olive trees in the garden, and these are traditionally supposed to have been there at the time of our Lord. In the centuries intervening between the Crucifixion and the visit of the Empress Helena to Jerusalem in 326 A.D. direct and conclusive evidence as to the actual location had been lost, and the present site was fixed upon at that time. The present appearance of the garden, however, is in accordance with the description as found in the Gospels. Another site, a little to the north, is claimed by some as the true site. Consult Condor, 'The Bible Places' (London 1897); Sanday, 'Sacred Sites of the Gospels' (Oxford 1903); and especially Smith, G. A., 'Jerusalem' (London 1908).

GETTY, George Washington, American soldier: b. Georgetown, D. C., 2 Oct. 1819; d. Forest Glen, Md., 3 Oct. 1901. He was graduated from the United States Military Academy in 1840, fought in the Mexican and Seminole wars, in the Civil War attained the brevet rank of major-general, United States army. He subsequently was commander of numerous military districts; was transferred to the artillery in 1871 and retired from the service in 1883.

GETTYSBURG (named after Gen. James Gettys), Pa., a borough and county-seat of Adams County, 35 miles southwest of Harrisburg; on the Gettysburg and Harrisburg and Western Maryland railroads. It is the seat of a Lutheran theological seminary founded in 1826, and Pennsylvania (Gettysburg) College (Lutheran) founded 1832. One of the most famous battles of the Civil War was fought here on 1, 2 and 3 July 1863. (See GETTYSBURG, BATTLE OF). The location of the borough among the hills of southern Pennsylvania, near the Maryland boundary line, is decidedly picturesque, and the region is well adapted to agriculture. A national park now includes the entire battlefield, and a national cemetery, dedicated by President Lincoln 19 Nov. 1863, contains 3,629 graves — nearly one-half those of the "unknown" dead. The borough, dating from 1780 and incorporated in 1806, is governed — under the charter of 1853 — by a burgess and council. Pop. 4,400.

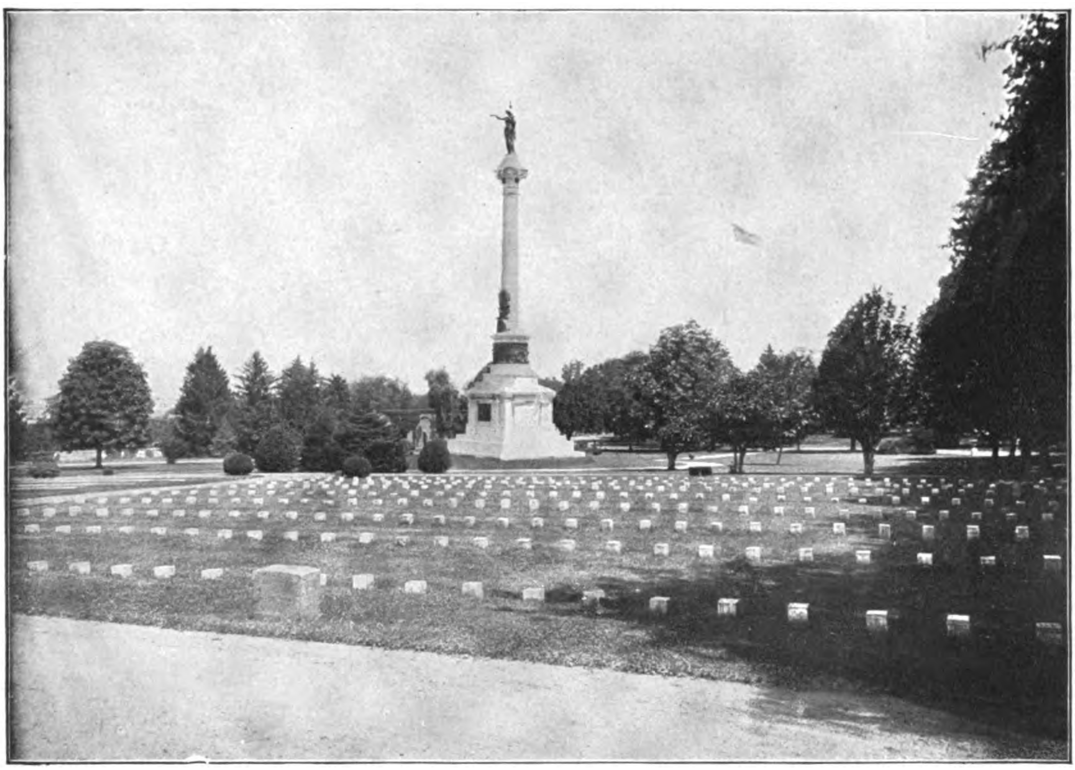
GETTYSBURG, Battle of, the most important event of the American Civil War and the turning point in the long and stubbornly-fought contest.

Preliminary Campaign.— After the battle of Chancellorsville (q.v.), 1–3 May 1863, the opposing armies resumed their positions on the Rappahannock, Lee's army on the south side of the river, at Fredericksburg, Hooker's on the north side, opposite. Encouraged by victory, and desiring to relieve Virginia of the presence of the Union army, Lee determined to transfer the seat of war north of the Potomac. His army, 1 June, was composed of the three corps of Longstreet, Ewell and A. P. Hill, and Stuart's cavalry force of 12,000 men, in all about 76,000, with 190 guns. Hooker's Union army was composed of seven corps, the First, commanded by Reynolds; Second, by Hancock; Third, by Sickles; Fifth, by Meade; Sixth, by Sedgwick; Eleventh, by Howard; and Twelfth, by Slocum; aggregating, 10 June 82,000 infantry and artillery "present for duty and equipped," with 410 guns, to which were added Pleasonton's cavalry force of about 12,000.

Lee began his campaign 3 June by sending Longstreet and Ewell to Culpeper Court House, where the cavalry, under Stuart, was also concentrated. A. P. Hill remained at Fredericksburg to watch and detain Hooker. Hooker suspected Lee's movement and, under his direction, Sedgwick laid bridges, crossed the river, and reported that Lee's main body seemed to be still there. Pleasonton was ordered to feel the position at Culpeper. Reinforced by two infantry brigades, he crossed the Rappahannock on the morning of the 9th, encountered Stuart at Fleetwood and Brandy Station (see FLEETWOOD OR BRANDY STATION, BATTLE OF), and reported the greater part of Lee's army at Culpeper, preparing to move on Washington. Hooker sent three corps up the Rappahannock to prevent Lee's crossing. On the 10th Lee sent Ewell, preceded by two brigades of cavalry, to the Shenandoah Valley to clear it of Union troops. Ewell defeated and dispersed Milroy's command at Winchester (see OPEQUON, BATTLE OF THE), took Martinsburg and cleared the valley; and on the 15th Rodes' division crossed the Potomac at Williamsport, sending Jenkins' cavalry brigade in advance to Chambersburg, and on the 19th moved to Hagerstown. Johnson's division crossed the Potomac and marched to Sharpsburg, and Early's moved to Shepherdstown to threaten Harper's Ferry. In these positions Ewell waited until the 21st for the other two corps to close up; when he advanced to Chambersburg. Longstreet moved from Culpeper on the 15th and, advancing along the east side of the Blue Ridge, occupied Ashby's and Snicker's Gaps. Stuart's cavalry was thrown out in front of Longstreet to watch Hooker, and on the 17th had a severe fight with the Union cavalry at Aldie and was driven back to Middleburg. A series of cavalry combats ensued, at the end of which Stuart was driven behind the Blue Ridge. On the 24th Longstreet moved by way of Berryville, crossed the Potomac at Williamsport on the 25th and 26th, and marched to Hagerstown, thence on the 27th to Chambersburg. A. P. Hill remained at Fredericksburg until the 14th, when, Hooker having fallen back, he moved down the Shenandoah Valley, crossed the Potomac at Shepherdstown, and joined Longstreet at Chambersburg. Stuart was left to guard the passes of the Blue Ridge and watch Hooker, whom he was to harass as much as possible, should he attempt to cross the Potomac. Meanwhile Hooker, starting from the Rappahannock on the 13th, was moving cautiously back toward the Potomac and covering Washington. On the 25th, 26th and 27th he crossed the Potomac at Edward's Ferry, near Leesburg, and on the 28th his army was grouped about Frederick, with Slocum's corps on the left near Harper's Ferry. He desired to send Slocum's corps and the 10,000 men, composing the garrison at Harper's Ferry, against Lee's rear, but General Halleck, commander-in-chief, refused the request for the garrison, and Hooker asked relief from command. His request was promptly granted, and 28 June Gen. George G. Meade was assigned to the command. Halleck granted Meade's request to utilize the garrison at Harper's Ferry and Meade ordered the abandonment of the place and the transfer of the garrison to Frederick and Washington.

Lee, deprived of the use of his cavalry, had been unable to get information of Hooker's movements; and to retain him on the east side of the mountains, after he had entered Maryland, Ewell had been instructed, on the 24th, to send a division across the South Mountain to threaten Baltimore. Early's division, detailed for the purpose, went as far east as York, the other two divisions of the corps marching from Chambersburg to Carlisle. Jenkins' and White's cavalry were in advance at Wrightsville and above on the Susquehanna, threatening to cross and take Harrisburg. Lee now made preparations to advance upon Harrisburg, but on the night of the 28th received information that the Union army had crossed the Potomac and was moving northward, its head of column already at South Mountain. His communications thus menaced, Lee resolved to prevent the further progress of the Union army by concentrating his own on the east side of the mountains; accordingly Ewell was ordered to turn back from the Susquehanna, Carlisle and York, and march for Gettysburg, and Longstreet and Hill were directed to march from Chambersburg to the same place. On the night of the 30th Rodes' division of Ewell's corps was at Heidlersburg, eight miles northeast of Gettysburg, with Early's and Johnson's

Entrance to National Cemetery



New York State Monument in National Cemetery

divisions near. Hill was at Fayetteville and Cashtown, eight miles from Gettysburg, and Longstreet was still at Chambersburg.

On the morning of the 29th under the impression that all of Lee's army was along the Susquehanna, Meade marched by three divergent roads in that direction and on the night of the 30th his forces were thus distributed. Buford, with two brigades of cavalry, was in advance at Gettysburg; Reynolds' First corps on Marsh Creek, five miles southwest of Gettysburg; Sickles' Third Corps at Taneytown, and Howard's Eleventh corps at Emmitsburg. These three corps, constituting the left wing of the army, were under command of General Reynolds. Hancock's Second corps was at Uniontown; Syke's Fifth corps at Union Mills; Sedgwick's Sixth corps at Manchester; and Slocum's Twelfth corps at Littlestown. Gregg's cavalry division was at Westminster. Kilpatrick's division, after a spirited fight with Stuart's cavalry at Hanover, bivouacked near that place. When Buford reached Gettysburg he went into camp just beyond the western limits of the town and threw out skirmishers three miles west and north.

The First Day's Battle.— Heth's division, the advance of Hill's corps, moved from Cashtown at 5 o'clock on the morning of 1 July, coming in sight of Buford's skirmishers about 9 o'clock, at which hour Buford fired his first gun as a signal for his skirmishers to open fire, and the battle of Gettysburg began. Heth advanced and Buford was slowly driven back, contesting every foot of ground, until Reynolds came up with Wadsworth's division, which became immediately and desperately engaged. During this encounter Reynolds was killed. Doubleday, succeeding to the command of the first corps, continued the contest. The other two divisions of the corps came up at 11 o'clock, followed at 12.45 by Howard's corps, one division of which was placed in reserve on Cemetery Hill, the other two forming on Doubleday's right along Seminary Ridge. Meanwhile Hill had arrived with the remainder of his corps, and Ewell, arriving at 2.30 P.M. with Rodes' and Early's divisions, formed on Hill's left. Hill made successive assaults on Doubleday from the west, and Ewell upon Howard from the north, which were repulsed; but finally, after desperate fighting and great losses on both sides, Early struck Howard in flank, causing him to give way, and the entire Union line was driven back through the town to Cemetery Hill, about half a mile south, which had been chosen by Howard as a rallying point for the two corps, and upon which he had placed one of his own divisions. When Meade heard that Lee's advance had reached Gettysburg, and that Reynolds had been killed, he was at Taneytown, 14 miles away, preparing to take up a defensive line along Pipe Creek. He ordered Hancock to ride forward and take command at Gettysburg. Hancock arrived as the Union troops were retreating through the town. He was struck with the advantages presented by Cemetery Ridge for a defensive battle and he determined to hold it and so notified Meade. He sent one of Doubleday's small brigades to hold Culp's Hill, on the right, and made an ostentatious display of Buford's cavalry on the extreme left. This show of force, and the great loss — over 7,000 — sustained by the Confederates during the day, caused Lee to defer operations. Two divisions of Sickles' corps came up at dark; Slocum's corps came about the same time, and Slocum, as ranking officer, assumed command of the field, Hancock riding back to report to Meade that Gettysburg — to which point Meade had already ordered the concentration of his army — was the proper place to fight a battle. Hill's and Ewell's Confederate corps were all up by night, and Longstreet bivouacked four miles in rear of Hill.

The Second Day.— General Meade arrived on the field at 1 o'clock on the morning of the 2d. All his troops except the Sixth corps were up by noon. The Sixth corps, having 34 miles to march from Manchester, did not come up until between 2 and 4 o'clock in the afternoon. The position on which Meade disposed his army was in the shape of a fishhook. As finally posted, the Twelfth corps was on the right at Culp's Hill, facing east; Wadsworth's division on its left, facing north; the Eleventh corps on Cemetery Hill, on the left of Wadsworth, its right facing northeast, its centre and left facing northwest, with Robinson's division of the First corps on its left, Doubleday's division in reserve. The Second corps, facing west, was on the left of Robinson; the Third corps on the left of the Second, with the Fifth, later in the day, on the extreme left. The Sixth corps was in rear of Round Top, on the left, as a reserve. Sickles, not satisfied with the position assigned the Third corps, moved to the front about three-fourths of a mile, from where Meade would have recalled him, but it was too late to do so in presence of a vigilant enemy.

The main part of Lee's army was on Seminary Ridge, a short mile west of Meade's left and centre; Longstreet on the right, with Hill on his left. Ewell's corps on the left held the town, and was at right angles to Hill and Longstreet. Pickett's division of Longstreet's corps had not come up. Skirmishing began in the morning. At 4 o'clock in the afternoon the battle opened by Longstreet's advance. He attacked Sickles with great fury and, although reinforced by Caldwell's division of the Second corps, and Barnes' and Ayres' divisions of the Fifth, after heavy fighting and great losses the Third corps and its supports were driven back beyond the main line. Longstreet followed, but was checked by a charge of Crawford's division of the Fifth corps and the firm and solid appearance of the Sixth corps. On Longstreet's right Hood's division advanced to seize Round Top, but was repulsed by Vincent's and Weed's brigades of the Fifth corps. Vincent and Weed were killed, and Hood wounded. During the latter part of Longstreet's engagement with Sickles two of Hill's brigades assailed Hancock's line and broke it, but were soon driven back. At about the same time Hays' and Hoke's brigades of Early's division assaulted Howard's line on Cemetery Hill, but were driven back with the assistance of two regiments and Carroll's brigade of Hancock's corps. Still further on the Confederate left Johnson's division of Ewell's corps assaulted Culp's Hill, then held by Wadsworth's division of the First corps and Green's small brigade of the Twelfth corps, the rest of the corps having been withdrawn and sent to the assistance of the left. Johnson's right, continuing the fight until late in the night, was repulsed, but his left entered, unopposed, the strong works thrown up by the Twelfth corps, and was perilously near the practically unguarded reserve artillery and ammunition train of the Army of the Potomac. Upon the return of the Twelfth corps during the night to its former position, finding it occupied, it waited until daylight before attempting to retake it. Meanwhile Johnson was being reinforced by three brigades, that he might hold his ground and renew his fight.

The Third Day.— The battle of the third day began by a struggle of the Twelfth corps to regain their works. At 4 A.M. the corps artillery, five batteries, opened a furious fire upon Johnson, at a range of 600 to 800 yards, other batteries followed, in the midst of which Johnson attacked the left of the Twelfth corps and the right of Wadsworth's division; the combat extended to the right, was taken up by Williams' division, and for six hours the struggle continued, at the end of which Johnson was repulsed. At 10.25 Johnson massed his forces in column of regiments and made a determined assault upon the right of Geary's division, by which, with the assistance of Shaler's brigade, he was repulsed, and driven beyond Rock Creek with a loss of nearly 2,000 killed and wounded, and three colors. At 11 o'clock the battle ceased on the Union right, with the Twelfth corps line fully re-established. There was more spectacular fighting on other parts of the field, but none more desperate and bloody than on the wooded Culp's Hill. Meanwhile Lee was preparing an attack upon the left centre of Meade's army. Pickett's division had now come up, and Longstreet was directed to form a column of assault composed of Pickett's division, Pettigrew's division, and two brigades of Pender's division, under Trimble, of Hill's corps. To prevent Meade from reinforcing the threatened point, Stuart's cavalry was ordered to go around Meade's right and attack his rear; 135 guns were disposed on Seminary Ridge; and at 1 P.M. the signal-gun was fired, and the 135 guns opened fire to crush out all opposition at the point to be attacked; the fire was replied to by 85 Union guns, and for two hours the hills shook and the earth trembled. As soon as the Union fire slackened, the great column of attack moved forward, Pickett's division on the right and Pettigrew's on the left. Pettigrew was supported by the two brigades of Trimble, and Pickett by the brigades of Wilcox and Perry. Pickett and Pettigrew, at the start from Seminary Ridge, covered a front of 1,600 yards. They had 1,400 yards of open ground to traverse before reaching the Union line; and the assaulting column numbered 14,000 men. As soon as it started, the Union artillery opened on it with shot and shell, tearing great gaps in the line; as it came nearer, canister did its deadly work; it was attacked on both flanks; and as it approached the Union line, held by Gibbons' and Hays' divisions of Hancock's corps, a flame of musketry burst forth before which nothing could live, and the men began to retreat; but, on the right, Armistead, commanding one of Pickett's brigades, broke the Union line, and, with less than 100 men, crossed the Union works and seized a gun; a short hand-to hand encounter ensued; Armistead was killed, and his small party killed or captured. Pickett saw the failure of his assault, and ordered a general retreat, after losing over 5,000 men. Wilcox's and Perry's brigades, which should have supported Pickett's right, were not prompt in starting, became separated from it and, attacking the right of the First corps, were driven back, losing many prisoners, and the battle of Gettysburg was ended. On the Union right Gregg's cavalry division, aided by Custer's brigade, defeated Stuart, after a severe fight, and thwarted his attempt on Meade's right and rear. On the left Kilpatrick, with two cavalry brigades, recklessly charged Confederate infantry in dense woods, and behind stone fences, west of Round Top, in which assault General Farnsworth, commanding one of his brigades, was killed. On the morning of 4 July Lee withdrew from his advanced positions, put his trains in motion for the rear, retreated at night and, followed and harassed by the Union cavalry, reached Williamsport on the 7th; but as the pontoon bridges had been destroyed and the Potomac had risen, he was unable to cross, and so entrenched. Meade followed by a circuitous route through Frederick and, after some delay, again confronted Lee on the 13th. He was about to attack when Lee recrossed the Potomac on the night of the 14th, his rear-guard, under General Pettigrew, being attacked by Kilpatrick, during which fight Pettigrew was mortally wounded and many prisoners were taken.

From first to last the Union forces on the field numbered about 88,000 effective men; the Confederate forces on the field numbered about 73,000 men. As officially reported, the Union loss was 3,072 killed, 14,497 wounded and 5,434 missing; aggregate of 23,003; the Confederate loss 2,592 killed, 12,709 wounded and 5,150 missing; an aggregate of 20,451.

Bibliography.— Alexander, 'Military Memoirs of a Confederate' (New York 1907); Bache, 'Life of Gen. George Gordon Meade' (Philadelphia 1897); Bates, 'Battle of Gettysburg'; Comte de Paris, 'The Battle of Gettysburg' (Philadelphia 1912); Doubleday, 'Chancellorsville and Gettysburg' (New York 1882); Drake, 'Battle of Gettysburg' (Boston 1891); Goodnow, 'The Battle of Gettysburg' (Washington 1896); Johnson and Buel, 'Battles and Leaders of the Civil War' (New York 1897); Long, 'Memoirs of Robert E. Lee' (New York 1886); Longstreet, 'From Manassas to Appomattox' (Philadelphia 1896); Nicolay and Hay, 'Abraham Lincoln' (New York 1890); 'Official Records' (Vol. 27); Pennypacker, 'General Meade' (New York 1901); Powell, 'History of the Fifth Army Corps'; Ropes, 'The Story of the Civil War' (New York 1913); Steele, 'American Campaigns' (Washington 1909); Swinton, 'Twelve Decisive Battles of the War' (New York 1867); Walker, 'General Hancock' (New York 1894); White, 'Robert E. Lee and the Southern Confederacy' (New York 1897).

E. A. CARMAN.

GETTYSBURG ADDRESS, delivered by President Lincoln at the dedication of the National Cemetery at Gettysburg, Pa., 15 Nov. 1863. "Of Abraham Lincoln (1809–1865) as an orator, the last of the great anti-slavery group, it is unnecessary to speak at length. The Lincoln-Douglas debates, the Cooper Institute speech, the Gettysburg oration, and the Second Inaugural need no comment beyond the reminder that the general consensus of mankind is that neither England nor America has furnished more perfect English or purer literature than are contained in the two last-named orations.» Consult Rines, I., 'The United States' (Vol. IX, p. 279, New York 1916). The Gettysburg oration reads as follows:

«Fourscore and seven years ago our fathers brought forth upon this continent a new nation, conceived in liberty, and dedicated to the proposition that all men are created equal. Now we are engaged in a great civil war, testing whether that nation, or any nation so conceived and so dedicated can long endure. We are met on a great battle-field of that war. We have come to dedicate a portion of that field as a final resting-place for those who here gave their lives that that nation might live. It is altogether fitting and proper that we should do this. But in a larger sense we cannot dedicate, we cannot consecrate, we cannot hallow this ground. The brave men, living and dead, who struggled here, have consecrated it far above our power to add or detract. The world will little note, nor long remember, what we say here; but it can never forget what they did here. It is for us, the living, rather to be dedicated here to the unfinished work which they who fought here have thus far so nobly advanced. It is rather for us to be here dedicated to the great task remaining before us, that from these honored dead we take increased devotion to that cause for which they gave the last full measure of devotion; that we here highly resolve that these dead shall not have died in vain; that this nation, under God, shall have a new birth of freedom, and that government of the people, by the people, and for the people, shall not perish from the earth.»

GEULINCX, Hĕ'lĭnks or zhĕ-lănks, **Arnold,** Dutch philosopher: b. Antwerp 1625; d. Leyden 1669. He was one of the disciples of Descartes (q.v.), and a leading exponent of the speculative doctrine known as Occasionalism. For 12 years, from 1646, he lectured successfully at Louvain, was then deposed for some reason not ascertained, and, after living at Leyden in great distress, was in 1665 appointed professor of philosophy there, but died four years later. His ideas are expounded in books entitled 'Saturnalia'; 'Logica'; 'Ethica,' published in his lifetime, and in 'Annotata præcurrentia ad Cartesii Principia' (1690), and 'Metaphysica Vera' (1691), which appeared after his death. The salient point of his teaching is an endeavor to explain the relations which obtain between soul and body, the mutual interaction of which under stimulus he ascribed to divine intervention and preordained arrangement. Consult Grimm, 'Arnold Geulincx'; 'Erkenntnisstheorie und Occasionalismus' (1875); Pfleiderer, 'Arnold Geulincx als Hauptvertreter der Occasionalistischen Metaphysik und Ethik' (1882).

GEUM, jē'ŭm, a genus of plants of the family *Rosaceæ,* distinguished from *Potentilla* by the hardened hooked styles which crown the carpels, so that the fruit becomes a burr. They are perennial herbs with pinnate or pinnatified leaves, and white, yellow or purple flowers. There are about 50 species, about 20 being found in North America. They are commonly known as avens. The roots of *G. rivale,* purple or white avens, and of *G. urbanum* have astringent and tonic properties. The latter is used for flavoring ale. *Geum strictum* is known as chocolate root. A few of the species are cultivated, *G. chiloense* being especially ornamental.

GEYSERITE, gē'sėr-īt, or **SILICEOUS SINTER,** is amorphous silica containing a varying amount of water. It is white or grayish in color, and is deposited about the geysers and hot springs of Wyoming, Montana, Iceland and New Zealand as hard masses or in filamentous or cauliflower-like forms, sometimes of great beauty. In the Upper Geyser Basin in the Yellowstone Park the formations of geyserites are abundant and most beautiful. The great terraces of the Mammoth Hot Springs are not geyserite, but are chiefly calcareous deposits.

GEYSERS, a name derived from an Icelandic work signifying «to burst forth with violence,» and applied to natural springs of hot water of the kind that were first observed in Iceland, and since in Yellowstone Park in the United States and in New Zealand. They may be described as volcanoes of hot water, for they resemble volcanoes in every particular — in the vibrations of the earth and dull rumbling sounds or loud reports by which the eruptions are preceded, in the intermittence of the phenomenon, and in the form of the opening at which the eruptions take place, like an inverted cone with a deep central throat. Natural philosophers are not agreed as to the mode in which this phenomenon is to be explained.

Cleland gives the following explanation: «When the [geyser] tube is so long [and narrow] that the water cannot circulate with rapidity, the water at some distance below the top of the tube will increase in temperature more rapidly than at the surface. Eventually the water at a depth of a number of feet will reach its boiling point with the resultant formation of bubbles of steam, which, in turn, will cause the water to spill over the edge of the opening. This overflow promotes boiling by reducing the pressure upon the water deep in the tube. As a consequence a large quantity of water, which was not quite at the boiling point because of the weight of the overlying column of water, will instantly burst into steam and will eject the overlying water from the tube, sometimes to a great height.» The best proof of the above theory lies in the fact that artificial geysers, constructed in conformity with the above idea, actually erupt periodically. In these the tube is of glass, and the steam action can be studied.

The geysers of Iceland lie about 30 miles west of Mount Hecla, and 16 miles north of the town of Skalholt, in a plain covered by hot-springs and steaming apertures. They are nearly 100 in number, and are scattered over a surface scarcely more than two square miles in extent. The two most remarkable are the Grand Geyser and the New Geyser or *Strokkur* (churn). The Great Geyser rises from a tunnel-shaped basin, lined and edged with silicious deposits. The pipe or throat at the bottom, from which the jet issues, is about 10 feet in diameter, and the basin at its outer edge is above 70. The emissions generally take place at intervals of six hours, and last for about five minutes at a time. The column, as measured by a quadrant, has been seen to rise as high as 212 feet. It is impossible to fix the age of the Great Geyser, but that its eruptions have taken place from the most remote antiquity is proved by the fact that, although there has been no sensible increase in the depth of the silicious deposit since the earliest recorded observations, it is now more than 16 feet deep.

The geysers of Iceland, long the only ones known to exist, are surpassed by those which have been discovered in comparatively recent times in the Yellowstone National Park. The largest of them is called the Grand Geyser. It begins an eruption by filling its basin with boiling water, forming a well 20 by 25 feet in diametric measurements, and having a visible depth, when quiet, of 100 feet. The explosion is preceded by clouds of steam rushing up to a height of 500 feet; the great unbroken body of water succeeds, ascending in one gigantic column to a height of 90 feet; while from the apex of the column there radiate five great jets, which shoot up to the unparalleled height of 250 feet from the ground. Among the other remarkable geysers of this district are those named Old Faithful, the Beehive, the Giant, the Giantess, etc. The number of hot-springs in the Yellowstone is not less than 1,500, all varying in times of action, force, deposits and color of water.

GEZER, an ancient city of Canaan. It is mentioned in Josh. x, 3 and xvi, 10, in connection with King Horam. As Gaz-ri, the city is noted in the Tell-el-Amarna letters. It fell into the hands of the king of Egypt, who gave it to the king of Israel in dowry for his daughter. In Maccabees, it is frequently mentioned as an important fortress. A palace was built there by Simon. Under Palæstina I it was made an episcopal city, called Gadara. It was also the scene of the defeat of Saladin by the Crusaders in 1177. Important excavations conducted by the Palestine Exploration Fund under the leadership of Macalister have unearthed interesting historical remains, revealing five main epochs, from the cave-dwelling period to the Canaanitish. The modern site of the city is at Ramleh.

GHALEB, gä-lĕb', the last of the great poets of the old Turkish school. His 'Husn-u-Ashk' (Beauty and Love), written about 1800, has been called one of the finest productions of Ottoman genius.

GHAVIAL, găv'ĭ-ạl. See GAVIAL.

GHEE, gē, or **GHI,** a peculiar kind of butter in use among the Hindus. It is made in the following manner: The milk when brought from the cow is poured into earthen vessels, in which it is boiled for one hour, often for two or three hours. It is then put in a cool place, and a little curdled milk is added. By the next morning the whole is converted into sour curdled milk. A layer of five or six inches deep is then taken off the top of the contents of each vessel, and is put into another larger vessel, in which the whole mass is gently stirred for half an hour with a split bamboo-cane. A little warm water is then added, and the stirring is continued for another half-hour, when the butter begins to form. After being kept for three days — a period long enough for the butter to become rancid in so hot a climate — it is melted in another earthen vessel and boiled until all the water it contains is evaporated. A little more curdled milk is then added, along with some salt or betel-leaves, and the butter, which is now ready, is then put in pots, in which it is kept till required. In this state it will keep for a long time, being sometimes used a year after it is made. This butter has naturally a very strong taste, insupportable to a European stomach, but it is in general use among the Hindus who are rich enough to buy it and is an important article of commerce.

GHENT, gĕnt, Belgium (French, Gand; Flemish, Gend or Gent), capital of the province of East Flanders, at the confluence of the Lys with the Scheldt. It is upward of eight miles in circumference, and is divided by canals into a number of islands connected with each other by bridges, of which there are about 200. Except in some of the older parts, it is well built, and has a number of fine promenades and many notable buildings. Among the latter are the cathedral of Saint Bavon, the crypt of which dates from the 10th century; the church of Saint Nicholas, the oldest in Ghent; the church of Saint Michael, with a celebrated Crucifixion by Van Dyck; the university (q.v.), a handsome modern structure, with a library of about 350,000 volumes and 700 manuscripts; the belfry, a lofty square tower surmounted by a gilded dragon, and containing chimes of 44 bells; the Marché du Vendredi, an extensive square, interesting as the scene of many important historical events; the town hall; Palais de Justice; Institute des Sciences; and Les Béguinages, extensive nunneries founded in the 13th century, the principal occupation of whose members is lace-making. Ghent has long been celebrated as a manufacturing town, especially for its cotton and linen goods and lace. Other industries of importance are sugar-refining, hosiery, thread, ribbons, instruments in steel, carriages, paper, hats, delftware and tobacco. There are also machine works, engine factories, roperies, tanneries, breweries and distilleries. The trade is very important. A canal connects it with the Scheldt at Terneuzen. Another canal connects the Lys with the canal from Bruges to Ostend. Ghent was mentioned as a town in the 7th century. In the 9th century Baldwin, the first Count of Flanders, built a fortress here against the Normans. Under the counts of Flanders, Ghent continued to increase. Two great revolts took place under the leadership of the Van Arteveldes (1338 and 1369) against Burgundy, and again in the 16th century against Charles V, and the citizens of Ghent, besides losing their privileges, had to pay for the erection of a citadel intended to keep them in bondage. In 1792 the Netherlands fell under the power of France, and Ghent became the capital of the department of Escaut (Scheldt). In 1814 it became, along with Flanders, part of the Netherlands, till the separation of Belgium and Holland. Ghent fell into German occupation after the fall of Antwerp in 1914. Pop. 167,477.

GHENT, Treaty of (24 Dec. 1814), the treaty which closed the War of 1812. The British advantage was enormous; the war had been discreditable and rather disastrous to

GEYSER

Old Faithful Geyser, in Yellowstone Park

America on land, half paralyzed as that country was by incompetent administration and dissensions among the States, while even the fleet had not maintained its early triumphs; the overthrow of Napoleon had let loose a mighty army, and had Great Britain persevered she might almost have exacted her own terms. But the British were tired of the burdens of a 20-years war, and the ministers were anxious to have done with fighting and settle down to peace; and American privateers and the American navy were playing havoc with their commerce. To our good fortune, also, the British sent third-rate negotiators to Ghent — Lord Gambier, Henry Goulburn and William Adams. America, on the other hand, sent some of the strongest men in the country: John Quincy Adams, James A. Bayard, Henry Clay, Jonathan Russell and Albert Gallatin.

In 1813, when Russia offered mediation, Bayard and Gallatin went to Saint Petersburg to negotiate, but England at that time refused the offer. Their instructions had included an article against impressment; but as it was notorious that the Napoleonic wars alone made this a practical question, and those were now ended, the government allowed them to waive that point. The British claims at first set up were extravagant and untenable: the establishment of the boundary fixed by the Indian Treaty of Greenville in 1795 (see GREENVILLE, TREATY OF), as a permanent line beyond which neither party should acquire territory, thus cutting off the entire Northwest from the United States; the cession of the mouth of the Niagara and Sackett's Harbor, in New York, prohibiting the United States from keeping land or naval forces on the Lakes; and allowing free navigation of the Mississippi to England. Finally the prolonged negotiations of the entire autumn and early winter ended in this treaty, which was scarcely more than an agreement to cease hostilities and settle the disputed questions at some other time. The questions of impressment, on which the war had been opened; of the extent of the right of blockade; of the American right to fish in British waters; of the British navigation of the Mississippi; and trade with the Indians; of the armaments on the Lakes; of the American claim for British spoliations — all were silently passed over. The treaty, as ratified 17 Feb. 1815, and proclaimed on the 18th, restored the status quo of territorial possessions except some islands in Passamaquoddy Bay; public or private property in the surrendered places not to be destroyed or removed; a commission was appointed to decide on the ownership of the islands above, the matter to be referred to arbitration if they failed to agree; and other commissions to settle the boundaries provided in the Treaty of Paris (1783) — from the Saint Croix to the Saint Lawrence at lat. 45° N., thence to Lake Superior, and from Saint Mary's River to the Lake of the Woods. The last article binds both parties to use their best endeavors to suppress the slave trade. The centenary of the signing of the Treaty of Ghent was the occasion of representative gatherings and of mutual felicitations on the part of the United States and Great Britain and Canada. Consult Adams, H., 'The United States' (Vol. VII, chaps. 4 and 14, 1891).

GHENT, University of, Belgium, founded 1816 by William I of Holland. In 1820 an old Jesuit college was remodeled for its use. Various other schools have been merged into the university. There were in 1913 1,253 students, of whom 272 were foreigners. The institution is maintained by the state, which supports a combined library of city and university, containing over 350,000 volumes.

GHERARDI, gā-rär'dē, **Bancroft,** American naval officer: b. Jackson, La., 10 Nov. 1832; d. Stratford, Conn., 10 Dec. 1903. He entered the navy in 1846, and was at the Naval Academy in 1852. He was lieutenant on the *Lancaster* of the Pacific squadron at the commencement of the Civil War, and in 1862 was made lieutenant-commander. During the war he commanded the *Chocorua* and the *Port Royal,* being on the latter vessel in the battle of Mobile Bay, in which he was distinguished for bravery and gallantry. He became rear-admiral in 1887; was commandant of the Brooklyn navy yard in 1887; commanded the North Atlantic squadron; and directed the Columbian naval review in New York Harbor in 1893. He retired in 1894.

GHETTO, gĕt'ō, a Jewish quarter in large cities. The ghetto of Rome, instituted in 1556 by Pope Paul IV, was removed in 1885, its demolition having been rendered necessary by the new Tiber embankment. The ghetto in New York is one of the largest and most densely populated in the world. In a single tenement building are housed as many as 600 persons and a single city block or square contains 3,000 to 5,000 inhabitants. The majority of these people are employees of the sweatshops. The ghetto in Prague (q.v.) is a noteworthy section of that ancient city. We mention also London's Jewry and similar quarters in the wealthy cities in northern Italy which (both cities and quarters) were more prominent in Renaissance days than in the centuries that followed.

GHIBELLINES, gĭb'ĕ-lĭnz, Italian political party of the 12th to the 15th centuries. On the death of Lothaire II, Emperor of Germany, 4 Dec. 1137, Conrad, Duke of Franconia and Lord of Weiblingen (which by corruption became Ghibelline), was elected his successor. His right to the imperial throne was, however, disputed by Henry the Proud, Duke of Saxony and Bavaria, who was in consequence declared an outlaw and shortly afterward died. His adherents transferred their allegiance to his son, Henry the Lion, at that time a boy of 10, and the whole empire was divided into the partisans of Conrad, who assumed the name of Ghibellines, and those of Henry, or the Guelphs. These titles were first used at the battle of Weinsberg in 1140. The strife between the two parties subsided in Germany, but continued in Italy, resulting in war in 1159. The supporters of the popes were termed Guelphs and those of the emperors Ghibellines. Charles of Anjou expelled the Ghibellines from Italy in 1268; but the contest between the two factions continued till the French invasion in 1495 united them against a common enemy. See GUELPHS.

GHIBERTI, gē-bĕr'tē, **Lorenzo,** Italian sculptor: b. Florence about 1378; d. there, 1 Dec. 1455. He early learned from his step-father, Bartoluccio, an expert goldsmith, the arts of drawing and modeling, and that of casting metals. He was engaged in painting in fresco at Rimini, in the palace of Prince Pandolfo Malatesta, when the priori of the society of merchants at Florence invited artists to propose models for one of the bronze doors of the baptistery of San Giovanni. The offering up of Isaac was to be executed in gilt bronze, as a specimen of the work. The judges selected the works of Donatello and Ghiberti as the best, but the former voluntarily withdrew his claims, giving the preference to Ghiberti. After 21 years' labor (1403–24) Ghiberti completed the door, and, at the request of the priori, executed a second, which occupied him from 1425–52. Michelangelo said of these, that they were worthy of adorning the entrance to paradise. During these 40 years Ghiberti also completed many other important designs, such as the bronze reliquary of Saint Zenobius, the sepulchral monuments of Dati and of the Abruzzi. The dryness of the school of Giotto appears in his early works; the later are in imitation of the Greeks, and are marked by continually increasing vigor and firmness. The reliquary and the baptistery doors of San Giovanni are, to this day, among the finest specimens of art in modern Italy. His work is inspired by the deepest religious feeling, and he succeeded in breaking down the narrow conventionalism that hampered the sculptor's art up to his time. Ghiberti also executed some excellent paintings on glass for the churches of Or San Michele and Santa Maria del Fiore. His 'Commentarii,' a work on Florentine art, is still preserved in MS. Consult Freeman, 'Italian Sculpture of the Renaissance' (London 1901); Perkins, 'History of Tuscan Sculpture' (Vol. I, London 1867); Scott, L., 'Ghiberti and Donatello' (London 1882); Vasari, 'Lives of the Painters' (10 vols., New York 1912).

GHIL, zhēl, **René**, French poet: b. Tourcoing, department du Nord, of Spanish parentage, 26 Sept. 1862. He made his literary début in 1884 with a volume of poems entitled 'Legendes d'âmes et de sang,' which he afterward disowned. He claimed for himself the title of «Maître de l'Instrumentation et de la Philosophie évolutive,» and expounded his principles in a 'Traité du verbe,' which ran into several editions. Not the least feature of his strange originality is the choice of titles for his books: 'Nature: I, Le Meilleur devenir; II, Le geste ingénu.'

GHIRLANDAJO, gēr-län-dä'yō, **Il** (originally **Domenico Bigordi**), Italian painter: b. Florence, 1449; d. there, 11 Jan. 1494. There were three brothers of this name (Davide, Benedetto and Domenico) among Italian artists of the 15th century, and Domenico was the greatest of the three. The great works on which his fame rests were painted in 11 productive years. He was thoroughly original and independent in his style and while he lived just after Masaccio and just before Michelangelo, he was distinct from either. He was skilful in portraiture and his large frescoes of religious subjects are historically interesting from the fact that he introduced as spectators of the incidents portrayed the figures of distinguished Florentines of his day. His great fresco of 'The Calling of Peter and Andrew' in the Sistine Chapel at Rome is much admired, and in his 'Last Supper' at Papiguano he has introduced the portrait of Amerigo Vespucci. His finest work is the 'History of Saint Francis' in the church of the Trinity at Florence. He was also a skilful worker in mosaics, which he called «painting for eternity.» He died of the plague in his 45th year and was buried in Sta. Maria Novella, in Florence. Consult Vasari, 'Lives of the Painters' (10 vols., New York 1912); Crowe and Cavalcaselli, 'History of Painting in Italy' (London 1903).

GHOST DANCE, a religious ceremony which originated among the Piute Indians in Nevada about 1889, so named from the fact that the dancers wear a white robe over their ordinary dress. It was the outcome of a religious belief which maintained that a messiah was soon to appear, who would rid the land of the white man and restore to the Indians all their rights. A Piute Indian named Wovoka, a native of Mason Valley, Walker Lake, Nev., and known among the whites as «Jack Wilson,» while in the delirium of fever claimed to be this savior and obtained a marvelous influence over not only his own tribes, but also all the Indians from the Missouri River to the Rockies. His teachings were very much the same as those of modern Spiritualists, he promising to procure them communication with the spirits of deceased friends. He advocated peace and refused to allow any references in their ceremonies to warlike subjects. The ghost dance is held at night, men and women joining hands and circling around, singing the ghost songs, which are principally chants in the form of messages from their spirit friends. Sometimes the participants appear to fall into a trance, during which they are supposed to commune with residents of the other world. The Sioux outbreak of 1890–01 was due indirectly to the ceremonies of this dance and the United States government sought to suppress it. Since that time no trouble has arisen, partly through the failure of Wovoke's prophecies to materialize at the scheduled time, but the dance is still practised by the Indians. (See INDIANS). Consult Worney, J., 'The Ghost Dance Religion' (Washington 1896).

GHOSTS. The belief that the spirits of the departed are occasionally presented to the sight of the living has existed in all ages and countries, and usually declines only when a people has advanced considerably in the knowledge of physical conditions and laws. We can understand the inability of the primitive man and the savage to realize death. The memory of the deceased lends power to call up his appearance. The primitive man does not observe accurately the distinction between fact and fancy — between what is seen in dream and what is seen in reality. (See DREAMS). The belief that man has a soul capable of existing apart from the body to which it belongs, and continuing to live, for a time at least, after that body is dead and buried, fits perfectly in such a mind with the fact that the shadowy forms of men and women do appear to others, when the men and women themselves are at a distance, and after they are dead. We call these apparitions dreams or fantasms, according as the person to whom they appear is asleep or awake; and when we hear of their occurrence in ordinary life, set them down as subjective processes of the mind. Among the less civilized races, the separation of subjective and objective impressions, which in this, as in several other matters, makes the most important difference between the educated man and the savage, is much less fully carried out. The Dyaks regard dreams as actual occurrences; and many savage races believe that dreams are incidents which happen to the spirit when it is wandering from the body. In sleep, the soul is supposed to leave the body and travel about. The man who fancies he sees at night the figure of a friend, or of an enemy, supposes he sees this dreamer's wandering soul. Among primitive races there is a superstitious objection to rousing a sleeper, lest he should awake before his soul has had time to return to the body. Death is regarded as another form of sleep; and during that sleep the spirit is wandering, and when wandering, may be met. See SLEEP.

Witchcraft, necromancy, has always been intimately connected with the spirits of the dead, and this is regarded as the parent of all religious worship. The savage man fears the dead and seeks to propitiate them, and gradually forgets that the ghosts are those of ancestors, and considers them as demons, a separate order of spirits; and, as he advances in intelligence, these demons cease to be altogether demoniacal, and become gods. Be that as it may, it is certain that the propitiation and even worship of the dead has formed an integral part of all primitive religions, and has maintained its hold among the more ignorant after it has ceased to affect the more educated.

The fear of seeing something often so dazzles and bewilders the visual organ that it sees the things that were feared. This accounts for many stories of the sight of apparitions in haunted houses. A crime is supposed to have been committed in some old house, and the superstitious believe that the spirit of the murderer or of the murdered person cannot rest. Whoever is nervous and timid, and visits this house at night, is predisposed to see the wandering spirit, and the fear that is present deprives the judgment of its power of taking accurate observations of what really is seen, and so superinduces a lax condition which is ready to be deceived. There may be conditions of body which allow of a sight beyond what is given to most, as it is certain that beasts see and scent and hear what our own faculties fail to perceive. But what we insist on is, that the greatest caution should be exercised in receiving stories of apparitions, and the utmost care taken to investigate every case of apparent spiritual manifestation. Before we can admit that there are genuine cases of ghosts having been seen, we must be satisfied that the observer was in full possession of his faculties, that his attention was on the alert, that he was capable of judging between subjective and objective presentments, and that he was healthy in mind and body.

In 1882 a Society for Psychical Research was founded in London for the scientific and systematic investigation of reported apparitions, clairvoyance, haunted houses, hypnotism, thought-reading and spiritualistic phenomena; it publishes regular reports of its investigations.

The subject of ghosts is treated from other and various viewpoints under APPARITION. (See also SPIRITUALISM; WITCHCRAFT). Consult Brewster, 'Natural Magic' (1832); Ingram, 'Haunted Houses' (1884); Jastrow, 'Ghostly Phenomena' (1910); Myers, 'Phantasms of the Living' (1886); Owen, 'The Debatable Land' (1874); Spencer, 'Principles of Sociology' (1885); Stead, 'Real Ghost Stories' (1891).

GHOSTS. As early as November 1880, when Ibsen was living in Rome, he was meditating on a new play to follow 'A Doll's House.' When he went to Sorrento, in the summer of 1881, he was hard at work upon it. It was finished by the end of November 1881, and, soon after its publication, Ibsen was deluged with letters from people decrying or commending it.

There were many lines in 'A Doll's House' which might be taken as indication of what the new play would be. Instead of the general query, "Did Nora return to her children"? the stress should have been laid on the problem of what would have happened to Nora's children had she and Helmer persisted in living the life they were accustomed to — a life of lies and subterfuges. The moral rottenness of Oswald Alving, his degenerate relationship with Regina, the serving maid, who proves to be in the end his half-sister, are the direct product of the moral unsavoriness of Captain Alving, whose past life has been covered through the moral smugness of his wife, acting under the advice of the conventional minister, Pastor Manders. If Dr. Rank, in 'A Doll's House,' was suffering from the sins of his fathers, Oswald Alving is the product of the moral degeneracy of his father and the moral weakness of his mother. Thus, Ibsen's 'Ghosts' becomes an answer to the question whether Nora had a right to leave her children when she did.

It was not an edifying canvas that Ibsen selected for his play, nor did he mean to have it so. What he sought to do was to show the gradual development of Mrs. Alving to that point where she reacts against the spiritual conventionality of Manders, and refuses any longer to respect or protect the memory of her husband, whose life was to have such an evil effect upon Oswald's physical and moral character. When, finally, in a revolting scene between Oswald and Regina, suggesting in its degeneracy what must have taken place between Captain Alving and Regina's mother, we at last get the awakening of Mrs. Alving to the unsound foundation upon which her family life had been resting all these years, Mrs. Alving's regeneration, we know, has come too late. The canker-worm eats inwardly and undermines the whole physical side of Oswald. The play ends in a most tragic manner, and yet the only way in which the play could end. Oswald's imbecility, which falls upon him as the moral atmosphere begins to clear, is the just retribution, and technically, as far as Ibsen's own art is concerned, produces one of the most remarkable instances of heredity taking the place of Greek Fate in its tragical workings.

The stage history of 'Ghosts,' since its first performance at Helsingborg, on 22 Aug. 1883, is varied in its continual progress. It was not given in London until 13 March 1891, at J. T. Grein's Independent Theatre, it having been held in check by the censor. "England," writes

William Archer, «enjoys the proud distinction of being the one country in the world where 'Ghosts' may not be publicly acted.» It was first produced in New York on 5 Jan. 1894, and by the New York Independent Theatre, in 1899, with Miss Mary Shaw as Mrs. Alving. In 1895–96 Madame Nazimova, with Paul Orleneff, gave a notable production of 'Ghosts' in a small room in the lower East side. When Nazimova was a student in Russia she wanted to «play Regina for my graduation piece at the dramatic school at Moscow, but they would not let me. 'Ghosts' was at that time prohibited by the censor, because its reflects on the Church.»

MONTROSE J. MOSES.

GHURI, goo'rē, an Asiatic dynasty who had the seat of their empire in the country of Ghur, and ruled over Persia, Afghanistan, northern Hindustan and Transoxiana. Ghur first appears in history in connection with Mahmud of Ghazni and his son Masaud, the latter of whom subjugated the region in 1020. About a century later Malik Izzuddin made himself ruler of all the Ghur country. His son, Alauddin Jahansoz (the Burner), fell upon Ghazni, and burned it to the ground. This prince's nephews, Ghiyassuddin and Muizuddin, established their power in Khorasan and Ghazni. The latter, crossing the Indus, then conquered successively the province of Multan (1176), Lahore (1186), and Ajmere (1190), and, in the course of the next six years all Hindustan as far south as Nagpur and east of the Irawaddy. On the death of Muizzuddin the Indian states asserted their independence, the power of the Ghuri being confined to Ghur, Seistan and Herât. This last feeble remnant was taken from them by the Shah of Kharezm about 1215. Some 30 years later the Ghur princes managed to revive something of their former power at Herât, which they retained by sufferance from the Mongols down to 1383, when the city was captured by Timur, and the Ghur sovereignty came to an end.

GHURKAS, goor'kąz, **GURKAHS,** or **GOORKHAS,** a tribe of northern India, named from the village of Ghurkas in Nepal, formerly the capital of the Ghurkas, before the formation of the present kingdom of Nepal. The Ghurkas are the mountaineers of Nepal, and speak a Sanskritic language. The Mohammedans drove them out of Rajputana and they migrated to Nepal, of which they took possession in 1768. When the English first invaded India the Ghurkas were formidable opponents, but are now most friendly. A large number of them are in the Anglo-Indian army, chiefly in the infantry, as they have no regard for the cavalry service. Besides their rifle they carry a formidable short-bent sword called a koorkree, with the edge on the inside of the bend, with which at close quarters they do dreadful execution. See NEPAL.

GIACOMOTTI, zhä'kō'mō'tē', **Félix Henri,** French artist: b. Quingey, Doubs, 19 Nov. 1828; d. 1909. He was a pupil of Picot at the Beaux-Arts, Paris; obtained the Grand Prix de Rome in 1854; established his studio in Paris in 1861, and painted numerous subjects from mythology, religious works and portraits. Among his canvases are 'Centaur and Nymph'; 'Christ Teaching in the Temple'; 'The Mount of Calvary.' He also executed a fresco for the ceiling of one of the salons of the Luxembourg representing the apotheosis of Rubens and paintings.

GIACOSA, Giuseppe, Italian dramatist: b. Colleretto Parella, Piedmont, 21 Oct. 1847; d. 2 Sept. 1906. His father, a distinguished lawyer and magistrate, destined him early for the bar, but an early dramatic attempt, 'Una partita a scacchi' (A Game of Chess), written in 1871 for private amateur performance, was so successful that it induced the young lawyer to seek a career in literature and the theatre. Giacosa's work as a dramatist may be roughly divided into three periods. His early plays, 'Una partita a scacchi,' 'Trionfo d'amore' (Triumph of Love, 1875), are romantic comedies in verse, dreamy dramatic legends of the Val d'Aosto of the 14th century. These were followed in 1877 by 'Il Fratello d'armi' (Brothers at Arms), a romantic drama in four acts. In the subsequent plays, while the plots are still laid in mediæval Piedmont, the author changes from the rhymed *Martelliani* of the comedies to an unrhymed hendecasyllable and turns to historical melodrama, a transitional step toward the more modern realism of his later works. This is the period of 'Il Conte Rosso' (The Red Count), 'Luisa' (1881) and 'The Lady of Challant,' the last written for Sarah Bernhardt and first produced by the French actress in America. With 'Tristi Amori' (Hapless Love) the healthy romanticism of Giacosa's early manner is abandoned for the modern social drama. Writing now in prose only, Giacosa interests himself in the conflict between idealism and various aspects of bourgeois materialism. In the powerful domestic triangle of 'Tristi Amori' (1888) and in the one-act 'Diritti dell' anima' (The Rights of the Soul, 1894), an Italian counterpart of Ibsen's 'A Doll's House,' the influence of the Scandinavian dramatist is apparent. 'Come le foglie' (Like Falling Leaves, 1900), a pitiless study of the disintegration of an Italian family, is a great modern play, and with 'Tristi Amori' represents the author at his best. Giacosa's last play, 'Il più forte' (The Stronger), produced in 1905, portrays the struggle between the antagonistic ideals of father and son. In addition to his work as a dramatist, Giacosa wrote in collaboration with Luigi Illica the libretti for Puccini's three operas, 'La Bohème,' 'Tosca' and 'Madame Butterfly.' He founded *La Lettura* in 1901, which magazine he directed until his death, 2 Sept. 1906. He was also the author of historical works, essays and short stories, among which 'Castelli Valdostani e Canavesi' (1898), 'Novelle e paesi valdostani' (1886), 'Impressioni d'America' (1898) are the most noted for their penetrating observation and for their clearness and vigor of thought. Consult Updegraff, A. and E., 'Three Plays by Giuseppe Giacosa' (New York 1913); Trombley, A. E., 'Unhappy Love' (Boston 1916); and translations in *The Drama* (Chicago 1911 and 1913). On the author see Ojetti, U., in the 'Nuova Antologia' (November 1906); Croce, B., in *La Critica* (Vol. VI); and Smith, S. A., in *The Drama* (May 1913).

ALFRED G. PANARONI.

GIANT CELLS, in pathology, a form of large cells many times the size of the cells of the body with which they are associated. They very frequently have a large number of nuclei, sometimes as many as 100 or more. It is supposed that giant cells originate from a lack of cell-division, rather than by a coalescence of a number of small cells. Many giant cells are found in the neighborhood of active growing tissue, associated with infectious disease processes, such as tuberculosis and carcinoma. It is thought that the function of giant cells is protective.

GIANTS, persons or races of extraordinary stature. History, both sacred and profane, makes mention of giants. The first mention of giants in the Bible is in Gen. vi, 4, where the Hebrew word used is *nephilim,* a word which occurs in only one other passage, where it is applied to the sons of Anak, who dwelt about Hebron, and who were described by the terrified spies as of such size that compared with them they appeared in their own sight as grasshoppers. A race of giants called the Rephaim is frequently mentioned in the Bible. In Gen. xiv, 5, and xv, 20, they appear as a distinct tribe, holding possessions in Canaan. At the period of the conquest of Canaan, Og, king of Bashan, who had a bedstead nine cubits long, is said to have remained alone of this tribe, but this must be taken to mean alone on the east side of Jordan; for giants, who were probably of the same stock, are subsequently mentioned as living about Mount Ephraim (Jos. xvii, 15) and among the Philistines (2 Sam. xxi, 18). Goliath, who measured six cubits and a span, and who was slain by David, is the most celebrated of the giants mentioned as living among the Philistines. The other races of giants who are mentioned in the Bible (besides the sons of Anak already referred to) are the Emim, who occupied the country afterward held by the Moabites, and the Zuzim (a branch of the Rephaim), who lived on the east side of the Jordan, between the Arnon and the Jabbok. In Deut. ii, 20, they are said to have been called by the Ammonites, who conquered them, Zamzummim.

The giants of Greek mythology are believed by some to represent the struggle of the elements of nature against the gods, that is, against the order of creation. They were said to have sprung from the blood of Uranus, which fell into the lap of Ge (the earth). Their mother, indignant at the banishment of the Titans into Tartarus, excited them to revolt against the gods. They hurled mountains and forests against Olympus, disdaining the lightnings of Zeus. An oracle having declared that the gods could not conquer except by the assistance of a mortal, Athene called Heracles to their aid. He slew Alcyoneus and Porphyrion, the most formidable of the giants. Apollo and Heracles shot out the eyes of Ephialtes; Dionysus slew Eurytus with his thyrsus; Hecate and Hephæstus killed Clytius with clubs of hot iron; Poseidon hurled a part of the island of Cos on Polybotes; Athene buried Enceladus under the island of Sicily and flayed Pallas and made a shield of his skin. The remainder perished under the hands of other deities by the thunderbolts of Jupiter or the arrows of Heracles. This fable perhaps indicates volcanic eruptions, for which the Phlegræan fields, where the chief scene of this struggle is placed and where the two principal giants were born, were remarkable. Cos and Sicily, which figure in this fable, are also volcanic. Ovid has described the war of the giants in the beginning of his 'Metamorphoses.'

Giants figure largely in Celtic and Scandinavian mythology and legends. In the legends of the Irish there are the two giants, Fingall or Finn MacCumhal and his son Ossian. The giants of the Welsh are familiar to everyone through the achievements of Jack the Giant Killer, the representative of the Scandinavian Thor, the destroyer of Skrimmer, and the Swiss giants.

Giants are rarer in occurrence than dwarfs, and like them and other abnormalities are frequently sterile. They are generally of a lymphatic temperament and are seldom long-lived. Legends and traditions that have been handed down of giant races having inhabited the earth in remote and prehistoric times have been discounted by scientific investigation, though fossil bones, which may be those of mastodons or mammoths, have been mistaken for those of giants. On the other hand, the belief that primæval man was of a dwarfish stature and that races of pigmies now existing represent the survival of the earliest are equally unfounded.

The following are regarded as in the main authentic instances of giant stature: In the time of Augustus there were to be seen in the Horti Sallustiani at Rome, the bodies of a giant, Posio, and a giantess, Secundilla, each 10 feet 3 inches high. In the reign of Claudius, an Arabian giant named Gabbaras, 9 feet 4 inches high, was exhibited at Rome. The Emperor Maximin, a Thracian, was nearly 9 feet high. A Jewish giant, about 10 feet high, is mentioned by Josephus. Long Mores, an Irish giant, of the time of Edward III, was 6 feet 10½ inches high. Queen Elizabeth's Flemish porter was 7 feet 6 inches; and J. Middleton, or the Child of Hale, born in 1578, attained the height of 9 feet 3 inches. C. Munster, a yeoman of the guard in Hanover, who died in 1676, was 8 feet 6 inches high; and Cajanus, a Swedish giant, about 9 feet high, exhibited in London in 1742. C. Byrne, who died in 1783, attained the height of 8 feet 4 inches; and Patrick Cotter O'Brien, a native of Kinsale, who lived about the same time, was 8 feet 7¾ inches. In 1884 died Pauline Wedde (called Marian), a German giantee, over 8 feet 2 inches at the age of 18; and in 1887 Josef Winkelmaier, an Austrian, 8 feet 9 inches, aged 22. Anna Swan, a native of Nova Scotia, above 8 feet high; her husband, Captain Bates, a native of Kentucky, of the same height; Chang-wu-gon, the Chinese giant, 7 feet 9 inches high; and Feeder Machow, a Russian, 7 feet 9 inches, are other instances.

GIANT'S CAUSEWAY, Ireland (deriving its name from a legend that it was the commencemeht of a road to be constructed by giants across the channel to Scotland), a natural pier or mole of columnar basalt, projecting from the north coast of Antrim, Ireland, into the North Channel, seven miles northeast of Portrush. It is part of an overlying mass of basalt from 300 to 500 feet in thickness, which covers almost the whole country of Antrim and the eastern part of Londonderry. It is exposed for 300 yards and exhibits an unequal pavement, formed of the tops of 40,000 vertical closely-fitting polygonal columns, which in shape are chiefly hexagonal. The diameter of the pillars varies from 15 to 20 inches. Each pillar is divided into joints of unequal length, the concave hollow at the end of one division fitting exactly into the convex projection of the other. The rock is compact and homogeneous and is somewhat sonorous when struck with a hammer. The Giant's Causeway is itself formed of three causeways, the Little, Middle or Honeycomb and the Grand Causeway. On the Little Causeway may be seen an octagon, pentagon, hexagon and heptagon all together; on the Middle Causeway is the famous Wishing Chair, with two arms and a back, on a platform where the columns rise to a height of about 10 feet. On the Grand Causeway are pointed out the Lady's Fan, an exact arrangement of five perfect pentagons surrounding a heptagon; the keystone of the Causeway — a sunk octagon; and the single triangle. At the starting point is the Giant's Loom, an imposing row of columns, 30 feet high, each intersected by about 30 joints; to the left is the Giant's Well, to the right the Giant's Chair. An electric tramway connects Portrush with the Giant's Causeway.

GIBARA, gē-bä'rä, Cuba, a seaport on the northern coast of Santiago province. It has a fine harbor protected by a fort at the entrance. There is a military hospital here. The district is rich in timber; coffee, sugar and tobacco are among its products. Pop. 6,841.

GIBBES, Robert Wilson, American scientist and historian: b. Charleston, S. C., 8 July 1809; d. Columbia, S. C., 15 Oct. 1866. He was graduated from South Carolina College (Columbia) in 1827, from the Medical College of South Carolina (Charleston) in 1830. In 1827–35 was assistant professor of chemistry, geology and mineralogy in the South Carolina College, in 1852–60 was a newspaper editor at Columbia and in the Civil War was surgeon-general of South Carolina. His contributions to science appeared in the 'Journal' of the Academy of Natural Science and other learned publications. His paper on 'Typhoid Pneumonia' (*American Journal of the Medical Sciences*, 1842) was the first to urge the substitution of stimulants for the knife in the treatment of that disease. He published 'Documentary History of the American Revolution' (3 vols., 1853–57).

GIBBET, jib'ĕt, a gallows, formerly in use in certain European countries, on which the bodies of criminals who had been guilty of particularly atrocious crimes were suspended after execution, encased in an iron frame near the spot where the crime was committed.

GIBBON, gi'bŏn, **Edward**, English historian: b. Putney, Surrey, 27 April O. S. (8 May) 1737; d. London, 16 Jan. 1794. He was the eldest son of Edward Gibbon and Judith Porten. The family was originally Kentish, and Gibbon gives some extended account of its origin in his justly celebrated 'Memoirs.' He there erred, however, as he suspected before the close of his life, in tracing the connection to Robert Gibbon of Rolvenden. He was really descended from Thomas Gibbon of West Cliffe, a younger branch of the family. It is significant that the arms of the younger branch, rather than that of the Rolvenden Gibbons, appears on the Gibbon bookplate, perhaps one that his father had used before him.

Gibbon's father was a care-free pleasure-loving gentleman. He married against his father's wishes and lost thereby a large share of an ample fortune. He lost still more in the expensive pleasures of the mid-18th century, in which he took a too active part. His public life was limited to sittings in two Parliaments as a Tory, and to an aldermanship of the city of London for a few months. After some 10 years of married life Gibbon's mother died and his father, deeply mourning his loss, but also deeply in debt, retired to Buriton and the quiet life of a secluded country gentleman.

Gibbon's grandfather was a man of more force of character. The son of Matthew Gibbon, linen-draper of London, he became an unusually successful business man. He contracted to clothe King William's troops in Flanders. He was made one of the commissioners of customs and was commended by Lord Bolingbroke for his exceptional knowledge of the trade of England. He became a director of the ill-starred South Sea Company, only to lose the labors of 30 years in the crash of 1720. Yet before his death, 16 years later, he amassed another fortune, almost, if not quite, as large as the first.

The future historian was a sickly child whose life was often despaired of. The famous practitioners of the time were frequently called to attend him. Fortunately, in addition to a mother's care, he had the loving devotion of her maiden sister Catherine, to whom he acknowledges that he owed his life. He was taught at home, partly by a domestic tutor, until almost nine, when he was sent to the school of Dr. Wooddeson at Kingston-upon-Thames. Here he remained some two years «reviled and buffeted» as a Tory, yet gaining an elementary knowledge of Latin «at the expense of many tears and some blood.» But the precocious boy was gaining more from his «early and invincible love of reading,» which was encouraged by his cultivated and judicious aunt. Of her he says, she was «the true mother of my mind as well as of my health.» He thus read Pope's 'Homer,' the 'Arabian Nights,' Dryden's 'Virgil,' Ovid's 'Metamorphoses,' besides «many English pages of poetry and romance, of history and travels.» Gibbon was next sent to Westminster School, which his father had attended before him. This was the easier because his aunt, who had been left dependent by the bankruptcy of her father, now took charge of one of the homes for the boys and could still care for him. Yet his bodily afflictions sadly interfered with his studies. He was finally transferred to Bath and then to the house of a physician at Winchester. In his 15th year Gibbon's health wonderfully improved and after a few ineffective weeks in the home of Rev. Philip Francis at Esher, Surrey, he was quickly transferred to Oxford, where he became a gentleman commoner of Magdalen College in April 1752.

Even before this time the genius of the future historian had asserted itself in the character of his reading. Some 20 volumes octavo of a 'Universal History' were devoured by the mere boy as they appeared. He then took up individual work on ancient or modern times, ranging through a vast number with great rapidity. It was Echard's 'Roman History' that first led him to the period he was later to make his own. From this he extended his reading to the mediæval age of Europe and, before he was 16, had exhausted all English sources in his favorite field. While he was yet to make himself the authoritative scholar, he already showed that marvelous ability in acquiring historical knowledge that marked his later manhood.

This remarkable self-education may be emphasized the more because Gibbon was soon to experience the inadequacy of university training in his time. He entered Oxford before he was 15 years old. Yet he soon found that regular tasks were not enforced, that absence from the university was not noticed, that folly and even vice were not restrained. Though unusually fond of reading, as we know, he fell into idleness and the mild, if expensive, pleasure of travel. Only in the long vacation did he again read assiduously and begin his first independent work, an essay on the 'Age of Sesostris.' Under such circumstances it is not strange that Gibbon so severely arraigned the university in his 'Memoirs': "To the University of Oxford I acknowledge no obligation. . . . I spent 14 months at Magdalen College; they proved the 14 months the most idle and unprofitable of my whole life."

Yet Gibbon's mind was not wholly inactive at this time. The key of Magdalen library had been delivered to him and he was soon tempted by what he had heard of Middleton's 'Free Inquiry' (1749) as a dangerous book. Strangely enough he was repelled by the scepticism and led to consider seriously the claims of the Catholic Church. Falling in with a student who was already a Catholic, he was furnished with Catholic books and by boyish dependence on his own reason was led to embrace the faith. Not realizing the full consequences of his act he asked admission to the Catholic Church in June 1753. His father, to whom he wrote at once, unwisely disclosed the young man's conversion to the authorities at Oxford and he was forever excluded from the university.

The course taken by Gibbon's father in these unusual circumstances was to have more than one important effect on the historian's life. He was sent to Lausanne, Switzerland, to the home of a Protestant pastor, who became his tutor and guardian. Here he remained almost five years, pursuing a regular and valuable course of instruction with Pastor Pavilliard. Through the same instrumentality and his own reflections he again became a Protestant. He also learned French as a native, thus commanding another important literature. He acquired a thorough acquaintance with Latin and a beginning in Greek. He carried on with growing maturity his historical reading. His keenness for intellectual pursuits led him to correspondence with several European scholars, and he once visited and was received by Voltaire. So valuable were these years that Gibbon put the highest estimate upon them: "Such as I am, in genius or learning or manners, I owe my creation to Lausanne."

Nor must one other episode of those years be forgotten. At Lausanne the young Gibbon met and loved the brilliant and beautiful Susanne Curchod, daughter of a Swiss clergyman. The affection was sincere on both sides. But the engagement was conditioned on the approval of Gibbon's father, on whom he was dependent, and that approval was promptly refused on his return to England. Under these circumstances Gibbon did what many another young man of his country has since done. He "sighed as a lover," he "obeyed as a son." And if the failure of marriage was harder for the daughter of the poor Swiss clergyman, she was consoled not many years after with what proved a more remarkable match. She became the wife of Necker, afterward French Minister of Finance, and the mother of Madame de Staël.

Before leaving Switzerland Gibbon had begun his first published work, his 'Essay on the Study of Literature.' It was written in his adopted language and was the result of his classical studies, with which it especially dealt. It was completed in the year of his return to England, though not published until 1761. Then it gained some recognition on the Continent, where it was republished the following year. In England it was little noticed, though a translation was finally made.

Gibbon returned to England in 1758. As he had taken up no profession he was still dependent for the next 12 years upon his father's bounty. Two years and a half of this time (1760-62) he spent as captain in the South Hampshire militia, the result of a wave of military enthusiasm which had swept England on a threatened invasion by the French. This largely withdrew him from historical studies, but he acknowledges that these years again made him an Englishman and that the military experience had "not been useless to the historian of the Roman Empire." Every vacation, too, was spent with his beloved books, and he meditated for treatment several historical subjects, among them the life of Raleigh, the liberty of the Swiss and a history of the republic of Florence.

As soon as he was freed from the militia, Gibbon hastened to the Continent to complete his education by travel and study. In this he spent another two years and a half, at Paris, Lausanne and in an extended Italian tour. Everywhere he was reading as well as seeing, so that it is not strange that on this tour he should finally have chosen the subject of his life work. The resolution was taken in Rome as he sat musing in the evening, while the Franciscan friars "were singing vespers in the temple of Jupiter on the ruins of the capitol." It was 15 Oct. 1764, and Gibbon had about half completed his 28th year.

Yet the great work could not be immediately begun. Gibbon was still dependent. At home he could not be master of his time. In London he could not use his books. Other plans also intervened in the five years following his second return to England (1765). His friend Deyverdun visited him and with his assistance Gibbon undertook the history of the Swiss, writing it also in French. But the historian was unacquainted with German and far from the Swiss archives, so that the first book of his projected work was finally committed to the flames. Then Gibbon assisted his friend in the 'Mémoires Littéraires de la Grand Bretagne,' which were published in 1767 and 1768. In 1770 he also printed anonymously his

'Critical Observations on the Sixth Book of the Æneid,' a brilliant and conclusive answer to a theory of Warburton in his 'Divine Legation of Moses.'

Meanwhile the historian had begun the more serious study of his Roman subject in 1768, after the failure of the Swiss project. Two years later he was left independent at his father's death, and establishing himself in London in 1772 he began the composition of his 'History of the Decline and Fall of the Roman Empire. On the death of Goldsmith (1774) he was made professor of history at the Royal Academy. The same year he was elected to Parliament, "at the beginning of the memorable contest between Great Britain and America." Yet he was to attain fame not by tongue but by pen. Silent in the House of Commons, he sprang at once into public esteem when the first volume of his 'History' issued from the press in 1776. The first impression was soon exhausted. A second edition was sold and a third printing within a year. "My book," he says, "was on every table and almost on every toilette; the historian was crowned by the taste or fashion of the day, nor was the general voice disturbed by the barking of any profane critic." The lasting fame of the author was once for all established.

From the publication of the first volume of the 'Decline and Fall' to the issue of the last three (1788) is a period of 12 years, the whole period of collecting materials and composition covering two decades. Of these 12 years the first seven were the most active. After the first enthusiasm for his 'History' had subsided, a storm of clerical criticism burst upon his treatment of the growth of Christianity in the early centuries. This he did not at first answer, but when his good faith was attacked he at last replied in a 'Vindication' (1779). In the same year he prepared a state paper, the 'Mémoire Justicatif,' against the French course in relation to the American war. He was also made one of the Lords Commissioners of Trade. In 1781 he published the second and third volumes of the 'Decline and Fall.' The following year he lost his seat in Parliament and his place as Lord Commissioner, and though some offers were made of other public positions he never again took part in public life.

Gibbon now resolved on an unusual move for an Englishman. While by no means a poor man, he thought his income insufficient for English life. He therefore decided to remove to Lausanne and unite his establishment with that of his friend Deyverdun. To his friend and the place he was bound by ties of early affection. He could live well in Switzerland and yet save money. He could complete his 'History' and return to England at the age of 50 a comparatively rich man. So he explained his purposes and he finally settled in his new home in 1783. Four years later he returned to England with the last three volumes of the 'Decline and Fall,' which were published on his birthday, 1788. After a year in England, however, he went back to Switzerland, fully satisfied with his foreign residence. Deyverdun died in 1789, but Gibbon still clung to his adopted country.

He was now to undertake the one other important literary work of his lifetime. In the year of the publication of his 'History' he began the celebrated 'Memoirs,' which have delighted the world for more than a century. On these he was engaged at intervals for the next six years, and he left six different sketches covering more or less fully different portions of his life. The 'Memoirs' were finally printed in 1796 with the 'Miscellaneous Works' of the historian, edited by Lord Sheffield. The manuscripts remained in the possession of the Sheffield family for a century, when they were deposited in the British Museum and the whole of the six partial sketches were published. Then it was seen that Lord Sheffield had taken unusual liberties with Gibbon's autobiography, though preserving much the larger part of the sketches not overlapping.

In 1793 Gibbon hastened to England on the death of the wife of Lord Sheffield, his intimate friend. During the year he was still full of plans. He had once hinted a supplement to his 'History.' He now meditated a series of biographies of eminent Englishmen. He even set his hand to a prospectus which should announce the editing of English historical writers by John Pinkerton. But all such plans were to be stayed. A disorder with which he had long been afflicted led to dropsy, for which he was treated at different times in the fall of 1793. At last he became rapidly worse at the beginning of the new year and died very suddenly.

Gibbon's fame rests upon his one great undertaking, the 'History of the Decline and Fall.' It was the most monumental work of its age, as he was the most erudite historical student of his time. In his 'Memoirs' Gibbon hesitates to class himself with Hume and Robertson, but he is the only one of the three to outlive a century of wonderful progress in historical research. It is true some defects have been found in his famous 'History,' and newer views of historical development find some omissions. But the century-old work has been the basis for all later research, while it is still edited by learned historians instead of being replaced by labors of their own. See GIBBON'S AUTOBIOGRAPHY.

Bibliography.— For the 'Decline and Fall': Oxford ed., 8 vols., 1828; ed. by H. H. Milman, 12 vols., 1838-39; by W. Smith, 8 vols., 1854-55; latest and best by J. B. Bury, 7 vols., 1896-1900. French, German and Italian translations appeared in Gibbon's lifetime; Polish, Greek and Magyar since.

For 'Memoirs': 'Miscellaneous Works,' 2 vols., ed. by Lord Sheffield, 1796; 2d. ed., enlarged to 5 vols., 1814; 'Memoirs,' ed. by Milman, 1739; 'Letters of Gibbon,' ed. by Prothero, 2 vols., 1896; 'Autobiographies,' ed. by Murray, 1897; 'Memoirs,' ed. by O. F. Emerson, 1898; by G. B. Hill, 1900, and I. A. C. Morrison's study in the 'English Men of Letters' series, 1901. Notes on life in *Gentleman's Magazine*, lviii, lix, lxiv, lxvi; Egerton Brydges's 'Autobiography'; Boswell's 'Johnson'; Walpole's 'Letters'; Mme. de Deffand's 'Letters to Walpole'; D'Haussonville's 'Salon of Mme. Necker' (1882); 'Girlhood of Maria Josepha Holroyd,' ed. by J. H. Adeane (1896); 'Historic Studies in the Vaud, etc.,' by Meredith Read (1897).

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GIBBON, a tailless anthropoid ape of the East Indies, the several species of which constitute the genus *Hylobates* of the family *Simiidæ*. They are nearly allied to the orangs and chimpanzees, but are smaller, of more slender form, and their arms are so long as almost to reach the ground when the animal assumes an erect posture; there are also naked callosities on the buttocks. In general the gibbons are the lowest among the anthropoid apes, and connect them with the Old World monkeys by way of the semnopithecine group. (See LANGUR). The gibbons are inhabitants of forests, their long arms enabling them to swing themselves from bough to bough, which they do to wonderful distances and with extreme agility. They cannot, however, move with ease or rapidity on the ground. The conformation of the hinder extremities adds to their difficulty in this, while it increases their adaptation to a life among the branches of trees, the soles of the feet being much turned inward. None of the gibbons are of large size, averaging about three feet tall. Eight or ten species are named in the books, but probably increased knowledge will reduce this number. One, the siamang (*H. syndactylus*), has the second and third digits of the hind limb partly united, and the hair of the upper arm pointing downward, while that on the forearm grows upward. It is a native of Sumatra, and has been set apart as the type of a separate genus (*Siamanga*) by some naturalists. The other species have the digits mostly free; they are natives of Cambodia, the Malay Peninsula, Sumatra and Java, and are known as lars, hoolocks, agile gibbons, white-handed gibbons, etc., but are much alike. One species is called 'wow-wow' in imitation of the howling cry that is characteristic of all. Consult any work on natural history and Hartmann's 'Anthropoid Apes' (1886).

GIBBONS, Abigail (HOPPER), American philanthropist: b. Philadelphia, 7 Dec. 1801; d. New York, 10 Jan. 1893. She was daughter of Isaac T. Hopper (q.v.) and wife of James Sloan Gibbons (q.v.). She taught in Philadelphia and New York, in 1845 assisted in founding the Women's Prison Association, and was also a founder of the Isaac T. Hopper Home for discharged prisoners. In the Civil War she was active in Federal hospitals and camps. It was chiefly through her instrumentality that the New York State reformatory for women and girls was established by the legislature.

GIBBONS, Grinling, English sculptor and wood-carver: b. Rotterdam, 4 April 1648; d. London, 3 Aug. 1721. In 1671 Evelyn found him at Deptford carving on wood Tintoretto's 'Crucifixion'; and on Evelyn's recommendation he was appointed by Charles II to a place in the Board of Works, and employed in the ornamental carving of the choir of the chapel at Windsor. His works display great taste and delicacy of finish, and his flowers and foliage have almost the lightness of nature. For the choir of Saint Paul's, London, he executed the foliage of festoons, and those in lime-tree which decorate the side aisles. At Chantsworth, at Burleigh, at Southwick, Hampshire, and other mansions of the English nobility, he executed an immense quantity of carved embellishment. The ceiling of a room at Petworth is regarded as his *chef d'œuvre*. He also produced several fine pieces in marble and bronze. Among these are the statue of James II, Whitehall; the base of the statute of Charles I, at Charing Cross; and that of Charles II, at the Royal Exchange.

GIBBONS, James, Cardinal, American Roman Catholic prelate: b. Baltimore, Md., 23 July 1834. When very young he was taken by his father to Ireland to be educated. He returned to America in 1853 and resided in New Orleans until 1855, when he matriculated at Saint Charles College, near Ellicott City, Md., where he was graduated with distinction in 1857. He then pursued his theological course at the Seminary of Saint Sulpice and at Saint Mary's University, Baltimore. On 30 June 1861 he was ordained a priest, his first mission being at Saint Patrick's Church, Baltimore, where he was assistant. Transferred to Saint Bridget's Church, Canton, he ministered to a small congregation until 1865, when Archbishop Spalding made him chancellor of the archdiocese and his private secretary. The Second Plenary Council at Baltimore, 1866, made him its assistant chancellor, and in August 1868 he was consecrated titular bishop of Adramyttum *in partibus infidelium* and first vicar-apostolic of North Carolina, erected by bull of His Holiness, Pius IX, dated 3 March 1868. He found three churches, two priests and about 1,000 Roman Catholics scattered over the entire State. He opened a school, which he personally conducted; built six churches; introduced into the vicariate the Benedictine order at Belmont, Gaston County, where Mary Help abbey was later erected; established the Sisters of Mercy and built for them a school for whites and one for negroes in Wilmington. He made the personal acquaintance of every adult Roman Catholic in the State, and met them at their homes, traveling from the seaside to the mountains, up and down the State, and that none should be neglected. After four years he was translated to the see of Richmond in 1872. Here he erected five churches, Saint Peter's Academy in charge of the Xaverian Brothers, and Saint Sophie's Home for Old People in charge of the Little Sisters of the Poor, in Richmond, Va., and parochial schools in Petersburg and Portsmouth, Va., and enlarged Saint Joseph's Female Orphan Asylum, Richmond, Va. In 1877 Archbishop Bayley asked to have Bishop Gibbons appointed his coadjutor, and on the death of Archbishop Bayley in October of that year Bishop Gibbons became archbishop of Baltimore, the highest ecclesiastical dignity of the Roman Catholic Church in the United States. He headed the delegation of American prelates who visited Rome in 1883 to represent the affairs of the Church in the United States at the Vatican, and to outline the work of the Third Plenary Council to meet in 1884. Pope Leo XIII appointed Archbishop Gibbons to preside over the council. In directing the proceedings of the council he co-operated in the enactment of many important new decrees, made necessary by the progress and development of Catholicism in America; and these acts and decrees were, after mature deliberation, approved by the ecclesiastical authorities. Leo XIII expressed his approval of the action and course of Archbishop Gibbons and created him cardinal 7 June 1886, and on 30 June 1886 Archbishop Kenrick of Saint Louis, representing the Pope, bestowed the insignia of his office upon the newly-made cardinal. Cardinal Gibbons sailed for Europe the next year to receive the apostolic benediction and to be admitted to membership in the college of cardinals, the 25th in succession. While in Rome he interpreted to the Pope the democratic spirit of American Catholicism in respect to the labor organizations in the United States and the exact relation existing between the employers and the employed. He was installed as pastor of his titular church 25 March 1887, and was assigned to the church of Santa Maria in Trastevere, a church of great antiquity, on the Tiber. He returned to America in November 1887; on 24 May 1888 laid the cornerstone of the Catholic University, Washington, D. C., and dedicated the divinity building 13 Nov. 1889. Cardinal Gibbons has been chancellor of the university since its foundation. In November 1888 he celebrated at Baltimore the centenary of the founding of the Catholic hierarchy in the United States, subsequently convening a congress of Catholic laymen, the first ever held in the United States. Cardinal Gibbons is president of the Bureau of Catholic Indian Missions, and is the first American cardinal to take part in the election of a pope. A model churchman, he is also a typical American citizen, loyal, progressive and public-spirited. On 20 Oct. 1918 his golden jubilee, commemorating an episcopate of half a century, the first American prelate to complete 50 years as a bishop, was celebrated with a special message from Pope Benedict XV, testimonials, congratulations, the attendance of delegations from all parts, including commissions from Italy, France and Great Britain. He has published 'The Faith of Our Fathers' (1876; 58th ed. 1903); 'Our Christian Heritage' (1889); 'The Ambassador of Christ' (1896), etc.

GIBBONS, James Sloane, American banker: b. Wilmington, Del., 1 July 1810; d. New York, 17 Oct. 1892. He early became a strong abolitionist, and in 1863 his house in New York was sacked by a mob, during the draft riots, because he had illuminated it in honor of Abraham Lincoln. His fame rests chiefly on his patriotic song, which was very popular during the Civil War, 'We Are Coming, Father Abraham, Three Hundred Thousand More.'

GIBBON'S AUTOBIOGRAPHY. Of the six memoirs written at various times and published under this title, the latest is the most finished, if not the most interesting. We could wish that the space given to Gibbon's family history had been devoted to fuller details of his own education, conversion to Catholicism and reaction therefrom. The style, admirably balanced and dignified, well conveys the man, whose sincerity is yet tempered by a certain coldness. One is somewhat jarred to read that Gibbon abandoned his engagement to the attractive Mlle. Curchod because of his father's disapproval, saying, "I sighed as a lover, I obeyed as a son": that father, of whose death he writes, "The tears of a son are seldom lasting." Characteristic, too, it is that he should use the word "*passion*" solely in reference to his studies. But the value of his record lies in the light it throws for us on the workings of his most distinguished mind, a mind which does not, like that of other writers, reveal itself wholly in its work. Without the autobiography we should not have known how Gibbon's habits of systematic industry and absorption in his task were fostered by his long residence in Switzerland and the friendships formed there. The composure of these pages, their steadfastness and elevation of thought, remain inspiring. From them we gain not only real knowledge of the man who wrote the 'Decline and Fall,' but a necessary insight into the influence of that greatest of all histories over the ideas of the 18th century.

ANNA ROBESON BURR.

GIBBS, Alfred, American soldier: b. Sunswick, L. I., 22 April 1823; d. Fort Leavenworth, Kan., 26 Dec. 1868. He was graduated from the United States Military Academy in 1846, served in the mounted rifles during the Mexican War, was brevetted captain, and until 1861 was employed in frontier and recruiting service. He served in the Federal army during the Civil War and attained the rank of major-general of volunteers and brevet brigadier-general United States army. He was mustered out of the volunteer service in 1866, became major of the Seventh Cavalry in that year, and until his death was stationed at various Kansas forts.

GIBBS, George, American mineralogist: b. Newport, R. I., 8 Jan. 1782; d. Newtown, N. Y., 5 Aug. 1833. Early becoming interested in the study of mineralogy, he collected during his travels in Europe, chiefly by purchase, a very extensive and valuable cabinet of minerals, the most extensive at the time that had been brought together in the United States. This collection he set up in the public rooms of Yale College, where it remained without charge from 1811–25, and in the latter year it was purchased for the college for $20,000.

GIBBS, James Edward Allen, American inventor: b. 1 Aug. 1829; d. Raphine, Rockbridge County, Va., 25 Nov. 1902. While a young man the subject of the sewing-machine was called to his attention and presently he thought out the idea of the revolving hook which is the main feature of the Willcox and Gibbs machine. In all he took out 12 patents covering the sewing-machine. The village in which he resided was named by him when he returned to it in middle life. The name is from the Greek word which means "to sew."

GIBBS, Josiah Willard, American philologist: b. Salem, Mass., 30 April 1790; d. New Haven, Conn., 25 March 1861. He was graduated at Yale College in 1809, and in 1824 was appointed professor of sacred literature in the theological department of Yale College, which he held till his death. He published a translation of Gesenius' 'Hebrew Lexicon of the Old Testament' (1824); 'Manual Hebrew and English Lexicon,' abridged from Gesenius (1828); 'Philological Studies' (1857); 'Latin Analyst' (1858), etc., and contributed to the periodical works of his time numerous important papers on topics of philology and criticism.

GIBBS, Josiah Willard, American mathematician: b. New Haven, Conn., 11 Feb. 1839; d. there, 28 April 1903. He was a son of the preceding and was graduated from Yale in 1858. He was professor of mathematics at Yale in 1871 and held the position at the time of his

HIS EMINENCE JAMES, CARDINAL GIBBONS

Archbishop of Baltimore

death. Thermodynamics was the field in which he achieved his greatest renown. He was original in his manner of teaching and extremely successful in the class room. The work that brought him first into prominent notice was his treatise on the 'Equilibrium of Heterogeneous Substances,' published in 1875 by the Connecticut Academy of Arts and Science. His last contribution on this subject was his book in the Bi-Centennial series at Yale, entitled 'An Elementary Treatise on Statistical Mechanics,' wherein he set forth what are likely to be the foundations of this branch of science in the future. In 1881 he began the development of the Vector analysis and applied it to problems in crystallography and to the computation of the orbits of the planets and comets and also to problems in the theory of light. His work gave strong support to the electro-magnetic theory and powerful influence in securing a general adoption of this theory by physicists.

GIBBSITE, gĭb'zīt, a mineral usually occurring in mammillary or stalactitic masses or incrustations, or in monoclinic crystals (hydragillite). Its color is usually white, often tinted with green, yellow or red. Its hardness is 2.5 to 3.5 and its specific gravity about 2.4. It is an aluminum hydrate, $Al\,(OH)_3$, containing 28 per cent of aluminum. It occurs in the Urals, Norway, Brazil and at Richmond, Mass. It was named after George Gibbs (q.v.).

GIBEAH, gib'ē-ä, the name of several towns in ancient Palestine, including the birthplace of Saul, and the scene of Jonathan's romantic exploit against the Philistines.

GIBEL, or **PRUSSIAN CARP,** a European carp (*Cyprinus gibelio*) of small size, without barbels and with a forked tail. It occurs in England and is good food.

GIBEON, one of the ancient cities of the Canaanites, in Palestine, a "great city" of the Hivites, who at an early stage of Joshua's conquests entered into a stratagem to get terms of peace for themselves. Taking old clothes on their persons, and dry and moldy bread in their bags, they professed to have come from a far country, and proposed an alliance with the Israelites, which was accepted by Joshua before the stratagem was discovered. When the discovery was made, the covenant was strictly observed, but the Gibeonites were condemned to be "hewers of wood and drawers of water unto all the congregation" (Jos. ix, 21). Joshua later protected Gibeon against the Amorites, and it was then that tradition put the time when the sun and moon stood still at Joshua's command. The town of Gibeon fell afterward to the lot of Benjamin. It was made a Levitical city, and the Tabernacle was transferred there from Nob after the slaughter of the priests. The engagement between the men of Abner and David took place here. Gibeon has been identified with the modern El-Jib. A large number of the Gibeonites, who had made a covenant with Joshua, were massacred by Saul, for which crime seven of Saul's sons were delivered up by David to the Gibeonites to be hanged (2 Sam. xxi, 1–9). Solomon sacrificed there at the beginning of his reign.

GIBRALTAR, jĭ-brâl'tạr (Sp. hē-bräl-tär'), a town and strongly fortified rocky peninsula at the southern extremity of Spain, province of Andalusia, at the western entrance of the Mediterranean, belonging to Great Britain. This remarkable fortress, which lies opposite Ceuta in Africa (distance between Europa Point and Ceuta 14½ miles), and forms the key to the Mediterranean, is connected with the mainland of Spain by a low sandy isthmus, the peninsula having the Bay of Gibraltar on the west and the open sea of the Mediterranean on the east. The British territory has a length of two and three-fourths miles and a greatest breadth of three-fourths of a mile, the greater part of it consisting of "the rock," at the foot of which, on the north, is a race course, cemetery, etc. The highest point of the rock is about 1,400 feet above sea-level. Its north face is almost perpendicular, while its east side also presents tremendous precipices. On the south it is almost inaccessible, making approach from seaward impossible; the west side, again although nearly as rugged and precipitous as the others, slopes toward the sea; and here the rock is secured by extensive and powerful batteries and other works, rendering it apparently impregnable. The body of the rock consists of a kind of dense limestone arranged in beds of 30, 40 and 50 feet in thickness. There are a number of remarkable caves in various parts of the rock, but all difficult of access.

Vast sums of money and an immense amount of labor have been spent in fortifying this celebrated stronghold. Numerous caverns and galleries, extending two to three miles in length, and of sufficient width for carriages, have been cut in the solid rock, forming safe and sheltered communications from one part of the garrison to another in cases of attack. Along these galleries are port-holes opening toward the bay or toward the Spanish territory (between which and the British territory there is a strip known as "the neutral ground"); while trees, shrubs and flowers of various kinds have been planted at different points, both for ornament and utility. On the summit of the rock there are barracks, signal-stations, etc. Of late years the fortifications have been carefully strengthened at every vulnerable point, and guns of the newest construction have been mounted in them. Gibraltar has a naval dockyard, and is a victualing and coaling station of the British navy. Great harbor works have been constructed, including a large area of sea enclosed by massy walls, and graving-docks large enough to accommodate the largest battleships. There are three extensive moles, respectively one mile, 3,660 feet and 2,717 feet in length. The materials have been mostly brought from the east side of the rock by means of a tunnel specially constructed for this purpose. Vessels entered in 1914, 4,247, with a tonnage of 6,323,658 tons.

The town of Gibraltar is situated on the west side of the peninsula, fronting the bay. It consists of two portions, the North Town and the South Town, the former being much the larger and separated from the South Town by the Alameda Gardens, parade ground, etc. The principal buildings are the governor's house, the naval hospital, the civil hospital, the garrison library, the courthouse, revenue offices, remains of an old Moorish castle, and the barracks. The water for the supply of the town and garrison is collected in tanks during the rainy season. Splendid reservoirs for water have recently been constructed by the government. Gibraltar is a free port, and serves as a valuable entrepôt for the distribution of British manufactures to the neighboring countries. The administration is that of a Crown colony, and is vested in the governor, who is also commander-in-chief of the troops. The settlement is treated as a garrison town, the power of enacting laws being vested in the governor alone. All criminal cases are determined according to the laws of England. Newcomers to Gibraltar are stringently looked after. Foreigners are permitted to remain during specified periods only, and on giving the required security. The revenue for 1914 was £89,721, and expenditure, £121,424. The currency is British, but Spanish money is freely circulated. The population in 1911 included 19,586 civilians and 5,340 military. The permanent residents are of very various origin — Spanish, Portuguese, Maltese, etc.

The name is formed from the Arabic words *gebel al Tarik* (the height or rock of Tarik), since Tarik Ibn Zeiad, the general of the caliph Valid, at the time of the irruption of the Moors into Spain (711 A.D., and following years), landed at the foot of this rock (known as the «Calpe» of antiquity and one of the «Pillars of Hercules» — Abyla in Africa being the other), where he founded a strong fortress. About the beginning of the 14th century it was taken from the Moors by Ferdinand, king of Castile, but in 1333 it was recovered by them, and was not finally acquired by the Spaniards till 1462, when it was taken in the reign of Henry IV. The Duke of Medina-Sidonia, who had assisted in gaining it for the Christians, took forcible possession of it for himself, and it remained in the keeping of his family till 1501, when the Spanish sovereign got it into his own hands. The third duke unsuccessfully tried to recover it in 1506, by which time the fortress had undergone altogether some half score of sieges. The pirates of Algiers subsequently made an attack upon it, but were forced to retire. The German engineer, Speckel of Strassburg, in the reign of the Emperor Charles V, substituted for the old Moorish fortifications works in the European style. In the war of the Spanish Succession the Spaniards were obliged to surrender this fortress 4 Aug. 1704, to the British admiral, Rooke, assisted by a body of troops under Prince George of Darmstadt. From October 1704 to April 1705 it was besieged by the Spaniards. It was secured to Britain by the Peace of Utrecht in 1713. Since this time nothing has been omitted by Britain to render this fortress, which forms a bulwark of her Mediterranean trade, absolutely impregnable. As the increasing value of the place rendered the possession of Gibraltar more desirable to Spain, the siege of it was commenced 7 March 1727, but raised upon the approach of Admiral Wager, with 11 ships of the line. Spain then offered £2,000,000 sterling for the delivery of the place, but in vain; and by a compact at Seville in 1729 Spain agreed to renounce all its claims upon it. Still the Spaniards omitted nothing to prevent all entrance into the fortress, and to cut it off from the mainland, by constantly strengthening the lines of Saint Roch and Algeciras. But it was easy to supply the inhabitants and garrison by sea. In the war which broke out between Britain and Spain in 1779 the last attempt was made for the recovery of Gibraltar. It now underwent the famous four years' seige from 1779 till 1783, but was ably and successfully defended by General Elliot, afterward Lord Heathfield. It was secured to Britain by the peace of 1783. Since that time in the various British and Spanish and also French wars, Gibraltar has been blockaded only on the land side. Consult Drinkwater, 'History of the Siege of Gibraltar' (1785); Mann, 'History of Gibraltar' (1870); and Spilsbury, 'Journal of the Siege of Gibraltar' (1908).

GIBRALTAR, Bay of, an inlet of the Atlantic formed by the headland of Cabrita and Europa Point, four miles distant from each other and is spacious and well adapted for shipping, being protected from all the more dangerous winds; the extreme depth within the bay is 110 fathoms. To increase the security of the harbor extensive moles have been constructed. The Spanish town and port of Algeciras lie on its western side.

GIBRALTAR, Straits of (anciently called PILLARS OF HERCULES); the straits connecting the Mediterranean Sea with the Atlantic Ocean, extending from Cape Spartel to Cape Ceuta on the northwest coast of Africa and from Cape Trafalgar to Europa Point on the southwest seaboard of Spain. They narrow toward the east, their width between Europa Point and Cape Ceuta being only 15 miles, while at the west extremity it is 24 miles. Length, about 36 miles. Through these straits a constant current runs so strongly from the Atlantic that sailing vessels bound west can pass them only by the aid of a Levanter, or strong breeze from the east. It is believed that the waters of the Mediterranean find an outlet here by means of an undercurrent.

GIBRALTAR OF AMERICA, Quebec, Canada; so called on account of its commanding situation and its one-time well-nigh impregnable defenses, both natural and artificial.

GIBRALTAR APE or MONKEY. See BARBARY APE.

GIBRALTAR OF THE EAST, a name given to Aden, a town and seaport of Arabia. Since 1839 it has belonged to the British and its fortifications have been greatly strengthened and improved. The citadel is built on a rocky eminence and is of great strategic importance, having a position between Asia and Africa like that of Gibraltar between Europe and Africa.

GIBSON, Charles Dana, American illustrator: b. Roxbury, Mass., 14 Sept. 1867. He studied at the Art Students' League (New York), became known as an illustrator for periodicals, particularly for 'Life,' and through his satirical presentations of wealthy society (but most of all by reason of his insistence upon an ideal type of «American girl,» or more properly «Gibson girl») attained a wide reputation. He has published 'London, as seen by C. D. Gibson' (1895–96); 'Pictures of People' (1896); 'People of Dickens' (1897); 'Sketches and Cartoons' (1898); 'Sketches in Egypt' (1899); 'The Education of Mr. Pip' (1899); 'Americans' (1900); 'A Widow and her Friends' (1901); 'The Social Ladder' (1902); 'Our Neighbors' (1905).

GIBSON, John, English sculptor: b. near Conway, Wales, 19 July 1790; d. Rome, 27 Jan. 1866. He was the son of a landscape gardener, and was apprenticed to a wood-carver at Liverpool, where he attracted attention by a figure of 'Time,' modeled in wax, which he exhibited at the age of 18. The patronage ot W. Roscoe (q.v.) assisted him to go to Rome, where he was cordially received by Canova. On the death of Canova in 1822 Gibson entered the studio of Thorwaldsen. In 1838 he was made a royal academician; but to the end of his life continued to make Rome his chief place of residence. Among his best works are 'The Wounded Amazon'; 'The Hunter and His Dog'; 'Hylas and the Nymphs'; 'Helen'; 'Proserpine'; and 'Sappho,' and busts of Auskisson and Sir Robert Peel. The subjects of most of Gibson's works are taken from classical mythology, but he was no servile imitator of the antique; on the contrary, he exhibited thorough originality in his treatment, and gave marked individuality and expression to the goddesses, nymphs and heroines of antiquity that proceeded from his studio. He was the author of one remarkable innovation, at least in modern sculpture, that of coloring his figures, and though he believed to the last that the experiments of this nature which he made were successful, he never succeeded in securing the approbation of other artists for the practice. He was a man of great kindliness of disposition, but so absent-minded that his friend and only pupil, Harriet Hosmer, the American sculptor, said of him: «He is a god in the studio, but God help him out of it.» His 'Life,' with an autobiography, was edited by Lady Eastlake (1870).

GIBSON, John Monro, British Presbyterian clergyman: b. Whithorn, Scotland, 24 April 1838. He received his education at University College and at Knox College, Toronto, where he studied theology. From 1864–74 he was minister at Erskine Church, Montreal; lecturer in Greek and Hebrew exegesis in Montreal Theological College 1868–74; minister of the Second Presbyterian Church at Chicago (1874–80). Rev. Gibson was appointed moderator of the Presbyterian Church of England in 1891, and was also president of the National Council of Free Churches (1897). He has published 'Ages before Moses' (1879); 'The Foundations' (1880); 'The Mosaic Era' (1881); 'Rock versus Sand' (1883); 'Pomegranates from an English Garden' (1885); 'Christianity according to Christ' (1888); 'Gospel of Matthew' (in 'Expositor's Bible' 1890); 'From the Outpouring of the Spirit to the Death of Saint Paul' (in 'People's Bible History,' 1895); 'Unity and Symmetry of the Bible' (1896); 'From Fact to Faith' (1898); 'A Strong City and Other Sermons' (1899); 'The Glory of Life' (1900); 'Apocalyptic Sketches' (1901); 'Protestant Principles' (1901); 'Devotional Study of Holy Scripture' (1904); 'The Inspiration and Authority of Holy Scripture' (1908).

GIBSON, Sir John Morison, Canadian legislator: b. township of Toronto, 1 Jan. 1842. He was graduated at the University of Toronto in 1863, and was called to the bar in 1867. He takes an active part in military affairs, served during the Fenian raid in 1866 and commanded an infantry brigade 1905–09. He was first elected to the provincial legislature in 1879; has held various portfolios, and was lieutenant-governor of Ontario 1908–13. He was created K. C. M. G. in 1912.

GIBSON, Randall Lee, American politician: b. Spring Hill, Woodford County, Ky., 10 Sept. 1832; d. Hot Springs, Ark., 15 Dec. 1892. He was graduated from Yale in 1853, studied law in Tulane (then the University of Louisiana) and Berlin, was a sugar planter in Louisiana until the Civil War, entered the Confederate army in the ranks, and finally attained the rank of major-general. Subsequent to the war he practised law, and having entered public life was elected to Congress as a Democrat in 1872, though not seated, was in the House from 1874–82, and in the Senate from 1882 until his death.

GIBSON, Robert Atkinson, Protestant Episcopal bishop: b. Petersburg, Va., 9 July 1846. He entered the ministry in 1870, was rector of Moore Memorial Chapel, Richmond, Va., 1872–78; of Trinity Church, Parkersburg, W. Va., 1878–87; and Christ Church, Cincinnati, 1887–97. In November of the year last named he was consecrated coadjutor-bishop of Virginia, succeeding to the bishopric on the death of Bishop Whittle in 1902.

GIBSON, Robert Williams, American architect: b. Essex, England, 17 Nov. 1854. He studied at the Royal Academy of Arts, came to the United States in 1881 and has since practised his profession in New York. He has designed many important American buildings, among which are the Episcopal cathedral at Albany, N. Y., and many churches, the Botanical Museum, New York, and banks at Buffalo, Albany, Utica and elsewhere; the New York Clearing House, United States Trust Company building, office buildings, country residences, etc.

GIDDINGS, Franklin Henry, American sociologist: b. Sherman, Conn., 23 March 1855. He was graduated from Union College in 1877, and engaged in journalism until 1888, when he became lecturer in political science at Bryn Mawr. In 1896 he became professor of sociology and the history of civilization at Columbia University. He has written 'The Principles of Sociology'; 'The Theory of Socialization'; 'The Elements of Sociology'; 'Democracy and Empire' (1900); 'Inductive Sociology' (1901); 'Descriptive and Historical Sociology' (1906); 'Pagan Poems' (1914); 'The Western Hemisphere in the World of Tomorrow' (1915). He has greatly aided in systematizing the facts and theories of his department, and is distinguished from other modern sociologists by the emphasis he lays on the «consciousness of kind» as the distinguishing motive of the social individual, and one of the chief factors in the organization of society.

GIDDINGS, Joshua Reed, American statesman: b. Athens, Pa., 6 Oct. 1795; d. Montreal, P. Q., 27 May 1864. He was admitted to the Ohio bar in 1820; elected a member of its legislature in 1826, and of Congress in 1838, where he was prominent as an opponent of slavery. Not only did he predict the tightening of the slavery chain about the neck of the two parties, but he foresaw the armed struggle. On different occasions in different speeches he prophesied the Civil War and as a political abolitionist sought to hasten it by using the power of political organization. In 1861 he was appointed consul-general to British North America. Among his works are 'The Exiles of Florida' (1858); 'The Rebellion: Its Authors and Causes' (1864).

GIDEON (Heb. Feller, Hewer), deliverer of Israel from the Midianites. These nomad Arabs of the Syrian and Arabian deserts had invaded the central district of Palestine. In one of their expeditions they had murdered Gideon's brothers at Tabor. He is called by an angel of the Lord to save Israel. He is also bidden to destroy the altar of Baal, and to erect a sacrificial altar to Jehovah in its place. He gains from the performance of this command the name of Jerubbaal. Collecting the men of his clan Abieger he surprises the Midianites under cover of night, drives them toward the Jordan and captures and slays the two princes Oreb and Zeb. Continuing his pursuit to the Jordan he overtakes and kills the kings Zeba and Salmunna. The Israelites wished to make Gideon king as a reward for his valor, but he asks merely for the golden earrings taken in the spoil, out of which he makes and sets up an ephod to Jehovah. The victory of Gideon is one of the remarkable events in Jewish history. "The day of Midian" is spoken of in the prophets, and allusions are found to it also in the Psalms, and even in the Book of the Revelation.

GIESSBACH (gēs'bäh) **FALLS**, Switzerland, a cataract of the Giessbach, falling into Lake Brienz, consisting of seven cascades, the largest of which has a fall of 190 feet.

GIFFEN, Sir **Robert**, English economist: b. Strathaven, Scotland, 22 July 1837; d. London, 12 April 1910. He was acting editor of the *Economist* under Walter Bagehot 1868–76; then founded the *Statist* and became chief of the statistical department in the Board of Trade and assistant secretary in 1882. He was John Morley's assistant on the *Fortnightly Review* in 1873–76; and is the author of reports, papers and essays which have given him a high rank. His works include 'American Railways as Investments' (1873); 'Stock Exchange Securities' (1877); 'Essays in Finance' (1879); 'The Progress of the Working Classes in the Last Half Century' (1884); 'The Growth of Capital' (1890); 'The Case Against Bimetallism' (1892); 'Economic Inquiries and Studies' (2 vols., 1904).

GIFFORD, Robert Swain, American artist: b. Naushon Island, Mass., 23 Dec. 1840; d. New York, 15 Jan. 1905. He studied with Albert Van Beest in Rotterdam, Holland; traveled through California and Oregon in 1869, and in Europe and North America 1870–71. He was best known as a painter of landscapes and seashore scenes, and among noted paintings by him were 'The Rock of Gibraltar'; 'A Lazy Day in Egypt'; 'Near the Coast'; 'Cedar Tree Pastures' and 'Ocean Sand Dunes.'

GIFFORD, Sandford Robinson, American artist; b. Greenfield, N. Y., 10 July 1823; d. New York, 29 Aug. 1880. He was educated at Brown University; studied painting in Europe 1855–57; and served in the Civil War. His works include 'A Lake Scene in the Catskills'; 'Ruins of the Parthenon'; 'Sunrise on the Matterhorn'; 'Home in the Wilderness'; 'Lake Geneva'; 'Fishing-Boats in the Adriatic'; 'San Giorgio, Venice'; 'Near Palermo'; 'Morning in the Adirondacks.'

GIFFORD, William, English critic: b. Ashburton, Devonshire, April 1756; d. London, 31 Dec. 1826. Left an orphan at 11 years of age, he became a cabin boy and was thereafter apprenticed to a shoemaker. Through the interest of a local surgeon he was sent to Oxford, afterward traveled on the Continent with Lord Belgrave for some years, and on his return to England devoted his time to literary pursuits. In 1794 he published 'The Baviad,' a poetical satire, in which the poetasters of the Della Cruscan school are the chief objects of his ridicule; and in 1795 appeared 'The Mæviad,' a severe animadversion on the degraded state of the drama. These works, though virulent and coarse, display much critical ability. In 1797 he became editor of the Anti-Jacobin newspaper — an office which involved him in a quarrel with Dr. Wolcot, against whom he published a pamphlet in verse, entitled 'An Epistle to Peter Pindar.' His translation of the 'Satires of Juvenal' was published in 1802, and is executed in a manner highly creditable to his abilities. He edited the plays of Massinger, with notes, and a life of that dramatist (1805); and afterward in a similar manner the works of Ben Jonson, Ford and Shirley. He also translated the 'Satires of Persius.' In 1809 he entered on the editorship of the *Quarterly Review*, of which he continued to be conductor till 1824, when he resigned. He showed himself a tactful editor and gathered round him a group of distinguished contributors; but he was an unscrupulous and violent partisan of the ultra-Tory type, and assailed bitterly the works of such men as Hazlitt, Hunt, Lamb and Shelley. His attack of Keats' 'Endymion,' which appeared in September 1818, with its sad sequel, is well known. He was interred in Westminster Abbey.

GIFFORD LECTURES. An annual lectureship on subjects in the field of Natural Theology, founded by Adam, Lord Gifford of Edinburgh — a Scottish jurist, judge of the Court of Sessions. He left by will for the foundation of the lectureship the sum of £80,000, divided among the four Scottish universities, £25,000 being apportioned to Edinburgh, £20,000 each to Aberdeen and Glasgow, and £15,000 to Saint Andrews. This is one of the most liberal foundations known. The lectures "may be of any religion or way of thinking, or (as is sometimes said) they may be of no religion, or they may be by so-called skeptics or agnostics or freethinkers." The first lectures were given in 1888, by Max Muller. In his volume the will is given in full. A list of the lecturers and subjects is given up to 1905 by L. H. Jordan, in 'Comparative Religion' (New York 1905, pp. 570–571). The following lectures have since been published: 1907–10, Ward, James, 'The Realm of Ends' (London 1912); 1909–10, Fowler, Wm. Warde, 'Religious Experiences of the Roman People from the Earliest Times to the Age of Augustus' (London 1911); 1910–12, Watson, John, 'The Interpretation of Religious Experience' (Glasgow 1912); 1911, Bosanquet, Bernard, 'Principle of Individuality and Value' (London 1912);

1912–13, Pringle-Pattison, Andrew Seth, 'The Idea of God in the Light of Recent Philosophy' (Oxford 1917); 1914, Balfour, Arthur J., 'Theism and Humanism' (London 1915).

GIFT, *in law,* a voluntary conveyance of property, usually without legal consideration, or the property so conveyed. The term is occasionally used in law to signify alienation either with or without consideration. To constitute a valid gift there must be an actual or constructive delivery of the property during the lifetime of the donor. This refers to both personal and real property. Formerly land could be conveyed by oral gift and delivery of possession only, but to-day such gifts usually must be in writing. Gifts are of two kinds: *causa mortis,* or those given while the donor believes himself in imminent danger of death, and *inter vivos,* or those given when the donor is in no fear of death. (See DONATIO CAUSA MORTIS). Examples of constructive delivery are: (1) A makes a gift of all the money he has on deposit in a savings bank to B and delivers the deposit book to him, assigning the money. (2) A makes a gift to B of all the goods he owns on a ship at sea and delivers to B a bill of lading for the goods.

In order that a gift may be legal, there must not only be actual or constructive delivery, but the donor must have acted of his own free will and be competent to contract. In addition, nothing must be necessary to make the gift complete and it must be effectual absolutely and immediately. Some authorities hold that the gift must be accepted by the donee to make it effectual, but this is not correct in all cases. Acceptance will be presumed in law if the gift is entirely beneficial, in the absence of evidence to the contrary. A mere expression of an intention to make a gift is not effectual, as where A gives his promissory note to B without consideration, payable in 90 days. The courts treat such transactions as unenforceable because made without consideration. After all the requisites above mentioned are complied with, the gift becomes irrevocable as between the parties, but under certain circumstances it may be attacked and set aside by creditors as in bankruptcy proceedings.

GIGANTISM, a rare form of disease supposed to be associated with changes in the pituitary body; characterized by abnormal processes of growth, chiefly in the bones of the face and extremities. Most giants, as seen in circuses, etc., have this disease or develop it in time. Technically the disease is known as acromegaly (q.v.).

GIGANTOPTERIS. A genus of very large, remarkable fern-like fossil plants from the coal fields in China and found also in Oklahoma and Texas. The age is Permian. The plant probably belongs in the Cycadofilices or Pteridosperms rather than among the ferns.

GIGANTOSTRACA, jī-găn-tŏs'tra-kạ. See EURYPTERUS.

GIGNOUX, zhēn-yoo', **François Regis,** French painter: b. Lyons 1816; d. Paris, 6 Aug. 1882. He studied at the Beaux-Arts and with Delaroche, and in 1840–70 was in the United States, where he became a national academician. Many of his work are in the possession of private collectors of New York. He painted chiefly studies of natural scenery, such as 'Indian Summer'; 'Niagara by Moonlight'; 'The Bernese Alps at Sunrise.'

GIGOUX, zhē-goo', **Jean,** French painter: b. Besançon, 8 Jan. 1806; d. 13 Dec. 1894. He studied at the Beaux-Arts, and as a pupil of Géricault and Sigalon, and achieved a high reputation by his historical works, religious and secular, in which he displayed forceful coloring and a faithful attention to detail. By his drawings on the stone, he did much to further the development of lithography. He executed 600 illustrations on wood for an edition of 'Gil Blas.' Among the best of his paintings are 'The Eve of Austerlitz'; 'The Death of Cleopatra'; 'The Good Samaritan' and 'The Death of Leonardo da Vinci,' his chief work, now hung in the Besançon Museum. The cross of the Legion of Honor was conferred on him in 1880. He published 'Causeries sur les artistes de mon temps' (1885).

GIHON, gī'hŏn, **Albert Leary,** American sanitarian: b. Philadelphia, Pa., 28 Sept. 1833; d. New York, 17 Nov. 1901. He was appointed assistant surgeon in the United States navy in 1855; took part in the attack and capture of the barrier forts, near Canton, China, in 1856; and served throughout the Civil War. He was promoted senior medical director in 1895, and was retired with the rank of commodore the same year. He served as president of the American Academy of Medicine, the American Public Health Association and the Association of Military Surgeons of the United States. He published 'Practical Suggestions in Naval Hygiene' (1871); 'Need of Sanitary Reform in Ship Life' (1877); 'Sanitary Commonplaces Applied to the Navy' (1877); 'Prevention of Venereal Diseases by Legislation' (1882); and was editor of *Annual of the Medical Sciences* for six years.

GIL BLAS, zhēl blăs. In France the Spanish novel of roguery was imitated during the 17th century chiefly by Sorel in 'Francion' and Scarron in 'Le Roman comique,' and, during the 18th century, most effectively of all, by Alain René Le Sage in 'Gil Blas.' This masterpiece of picaresque fiction consisted of 12 books, six published in 1715, three in 1724, and three in 1735. Le Sage was in his 48th year when the first instalment appeared, and already was known as a student and translator of Spanish letters. Long afterward, three several charges of plagiarism were brought against him, alleging his more or less complete dependence upon a Spanish original, Voltaire maintaining that Le Sage had merely adapted the 'Marcos de Obregon' of Vicente Espinel, Padre Isla assuming that he had exactly rendered into French a lost Spanish manuscript, and J. A. Llorente ingeniously attempting to identify this manuscript as a novel by Antonio de Solis y Rivadeneyra, which, he declared, Le Sage had further used in his 'Bachelor of Salamanca.' All three charges have been duly heard and dismissed by scholars, who at most have found, in 'Gil Blas,' a few passages suggested by the Spanish novels — especially by 'Marcos de Obregon' (1618) — together with Spanish local color and a picaresque plan. This plan involves the autobiography of an easy-going fellow rising through the service of various masters whose traits and wiles he describes in satirical vein. His shifts of condition enable him to survey ironically different social conditions. His ups and downs are many, but his main drift is from indigence to prosperity.

Le Sage perceived the possibility of thus reviewing French society and human nature in general, and the advantage of being able to cloak his satire beneath a Spanish disguise. He refined what was crude and inartistic in the Peninsular novels; he tempered his satire with wit; he universalized his situations and people, without sacrificing their picturesque quality; and he transformed his protagonist from a 'pícaro,' or rogue, into an agreeable adventurer. It is true that Gil Blas helps himself to his uncle's ducats on setting forth in the world, and is forced by bandits to rob on the highway, but, having been more sinned against than sinning, he turns to service, and thereafter is fairly loyal to his 15 successive masters. These range from a quack, an actress, and a decrepit old roué, to an elegant marquise, an archbishop, and the prime ministers of Philip III and Philip IV. Gil Blas shares the special folly of each of these masters, stooping to quackery with Sangrado, to gaming and intrigue with Mathias de Selva and to chicanery at court; but rising to rectitude with the righteous. He is literally all things to all men. In the end, however, he has learned that honesty is the best policy. His experiences in service occupy but half of the story, which is made up, for the rest, of accounts of his progress from town to town when out of a place, and of the activities of those whom he meets, and their extended life-histories. Although several tales are lugged in by main force, most of the many episodes are knit more closely to the main action than was ever the case in the Spanish novels.

As compared with these, 'Gil Blas' shows, further, a development of personality in its principal actors, the avoidance of any gross realism that might offend, a tendency to minimize the portrayal of low life and emphasize that of the middle and the upper classes, and to replace attacks upon particular evils by laughter at inconsistencies of character. Instead of ignoring morality, like the Spanish burlesque fictions, or tediously obtruding it, like 'Guzman de Alfarache' or 'La Pícara Justina,' 'Gil Blas' suggests, without a word of sermonizing, that virtue is the road to happiness. As a novel, it constitutes the most important link in the chain of picaresque influence that reaches from 17th-century Spain to 18th-century England. Smollett in particular felt its charm, but most of his contemporaries knew and admired it, and in all civilized countries it is to-day recognized as the finest example of its kind. The best single discussion of 'Gil Blas' will be found in 'Le Sage romancier' (1890), by Léo Claretie.

FRANK W. CHANDLER.

GILA, hē'lä, a river of the United States, an affluent of the Colorado. It rises among the mountains in the western part of New Mexico, and flows in a southwesterly direction across Arizona, its total length being about 470 or 480 miles. Its upper course and middle reaches are through mountains, with many deep and precipitous canyons; farther south and west it flows through an open and comparatively level country, the valley being productive when irrigated. About 200 miles from the Colorado is the reservation of the Maricopa and Pima Indians. Ancient ruins are numerous on the banks, bearing mute witness in part to a vanished aboriginal semi-civilization.

GILA MONSTER, the poisonous lizard (*Heloderma suspectum*) of the sandy deserts of the southwestern United States, so called because first brought to notice in the valley of the Gila River, Arizona, and on account of the great size (two feet in length) which it sometimes attains. Another "species" (probably a variety — *H. horridum*) exists in the arid parts of Mexico, where it is called "caltetepon" or crust-lizard. These constitute a family *Helodermatidæ*, characterized by the presence of pleurodont, fang-like teeth, each with a groove on its front and rear surface, and each having near its base a labial gland which was supposed to secrete venom of the same nature as that of serpents. The Gila monster has a rough and warty skin, variegated in black and yellow. Its poisonous nature is yet, however, undetermined, as there is a conflict of scientific authority on the point. Instances, however, are on record of its bite proving fatal to man. Its food consists of worms, centipedes, the eggs of birds and lizards, frogs and other small animals which its bite paralyzes or kills. Its anatomy is described in the 'Proceedings' of the Zoological Society of London (1900).

GILBERT, Anne Hartley, American actress: b. Rochdale, England, 21 Oct. 1821; d. Chicago, Ill., 2 Dec. 1904. She was a graceful dancer in early life, and later became very successful in high comedy. She was married to George Henry Gilbert, a dancer, in 1846. She visited the United States in 1846, and in 1849 made her home here. In 1869 she became a member of the Augustin Daly's company, her especial rôles being those of old women, in which she achieved very marked success. After Daly's death she was under the management of Charles Frohman, and later joined Miss Annie Russell's company. On 21 Oct. 1899, her birthday was observed by her admirers by a special performance, a reception and the presentation of a silver service at the Lyceum Theatre, New York. Consult her 'Stage Reminiscences' (1901); also Winter, W., 'The Wallet of Time' (2 vols., New York 1913).

GILBERT, Charles Henry, American ichthyologist and educator: b. Rockford, Ill., 5 Dec. 1859. He was graduated at Butler University, Indiana, in 1879, and became professor of zoology in the Leland Stanford University in 1891. In 1902 and 1906 he made important explorations for the United States Fish Commission, and in 1909–13 conducted investigations for the Bureau of Fisheries. He is the author of 'Synopsis of the Fishes of North America,' with David Starr Jordan (q.v.); 'The Deep Sea Fishes' (1905); 'Lantern-Fishes of Japan' (1913), etc.

GILBERT, George Holley, American clergyman and educator: b. Cavendish, Vt., 4 Nov. 1854. He was graduated from Dartmouth College 1878; Union Theological Seminary 1883, and the University of Leipzig with the degree of Ph.D. 1885. On his return to America he became acting professor of New Testament Literature in Chicago Theological Seminary and was professor from 1887–1901. He now resides at Dorset, Vt., devoting his time to literary work. He is the author of 'The Poetry of Job' (1888); 'The Student's Life of Jesus' (1899); 'The Student's Life of Paul' (1899); 'The Revelation of Jesus' (1900); 'The First Interpreters of Jesus' (1901); 'A Primer of the Christian Religion' (1902); 'A Short History of Christianity in the Apostolic Age' (1906); 'Interpretation of the Bible, a Short History' (1908); 'The Acts, the Second Volume of Luke's work on the beginnings of Christianity' (in the 'Bible for Home and School' series, 1908); 'Jesus' (1912); 'The Bible and Universal Peace' (1914); 'Jesus for the Men of To-day when Science Aids Religion' (1917).

GILBERT, Grove Karl, American geologist: b. Rochester, N. Y., 6 May 1843. He was graduated from the University of Rochester in 1862 and has been geologist of the United States Geological Survey from 1879. He has published 'Geology of the Henry Mountains' (1879–82); 'Lake Bonneville' (1890); the volume 'Glaciers and Glaciation' (in the report of the Harriman Alaska Expedition, 1904); 'Transportation of Débris by Running Water' (1914); numerous reports issued under the direction of the United States government and numerous papers in scientific journals.

GILBERT, Sir Humphrey, English navigator: b. Devonshire 1539; d. September 1583. He was a step-brother of Sir Walter Raleigh, studied at Eton and Oxford, and adopting the military profession, he served with reputation in France and Ireland. He was knighted in 1570, and sat in the House of Commons as member for Plymouth in the following year. Possessing a strong propensity for speculation and enterprise, he turned his attention to maritime exploration, projected voyages by both the northeast and northwest passages, and published 'A Discourse of a Discovery for a New Passage to Cataia' (1576); reprinted in Hakluyt's collection of voyages, Vol. III. In 1578 Sir Humphrey Gilbert obtained from the queen a patent empowering him to discover and colonize in North America any land then unsettled. His first voyage ended in failure, but in 1583 he sailed again with a small fleet, and on 5 August landed in Newfoundland, took possession of the harbor of Saint John's, and thus founded the first English colony in North America. He continued his explorations southward to Cape Breton Island, and on his return voyage to England in a small sloop was lost in a storm off the South Azores. Consult Hakluyt's 'Voyages'; Adams, 'English Heroes in the Days of Elizabeth' (1902); 'Lives' by Edwards (1868); St. John (1868); Tytlor (1833); Payne, 'Voyages of the Elizabethan Seamen' (1880); Slafter, 'Sir Humfrey Gylberte and His Enterprise' (1903).

GILBERT, Sir John, English painter: b. Blackheath, near London, 21 July 1817; d. Blackheath, 5 Oct. 1897. In 1836 he began to exhibit both in oil and water colors; and in 1852 he was elected an associate, in 1854 a member, in 1871 the president of the Society of Painters in Water Colors, receiving at the same time the honor of knighthood. He became a royal academician in 1876 and a chevalier of the Legion of Honor in 1878. His oil paintings include 'Don Quixote and Sancho Panza'; 'Education of Gil Blas'; 'Murder of Becket'; 'Joan of Arc Entering Orleans'; 'Crusaders'; 'Wolsey at Leicester' and 'Morning of Agincourt.' He was a well-known and popular illustrator of books and of one of the pioneers of pictorial journalism. He presented a number of his later works to public galleries in England.

GILBERT, Linda, American philanthropist: b. Rochester, N. Y., 1857; d. 1895. She became known for her work in the interest of prison reform and by her success in placing libraries in prisons. She was also foremost in obtaining the incorporation under the laws of the State of New York of the Gilbert Library and Prisoners' Aid Society.

GILBERT, Rufus Henry, American inventor: b. Guilford, N. Y., 26 Jan. 1832; d. New York, 10 July 1885. He was graduated at the New York College of Physicians and Surgeons; served as surgeon in the Fifth New York Infantry in the Civil War; and was appointed superintendent and medical director of the United States army hospitals. Owing to the failure of his health after the war he abandoned his profession and engaged in the railroad business, making a special study of the needs of rapid transit in New York. The result was the erection (1878) of the Sixth Avenue Elevated Railway in that city.

GILBERT, William, English physician and physicist: b. 1540 at Colchester; d. 1603. At the age of 18 he entered Saint John's College, Cambridge, from which he graduated in 1560. In 1601, he was elected president of the Royal College of Physicians, an honor which was followed by his appointment as chief physician to Queen Elizabeth.

Gilbert's fame rests on the discoveries which he made in electricity and magnetism and which he tersely recorded in his work on the magnet 'De Magnete magneticisque Corporibus,' published in London in 1600. He devoted all the time he could spare from his professional duties during a period of 18 years to the researches described in this remarkable treatise, which researches he informs the "candid reader" cost him over £5,000. By way of distinction, he marks his discoveries with marginal asterisks, large ones denoting important discoveries and small ones those of minor note. Of the former, there are 21; of the latter 178. Besides a remarkable titlepage, the work contains 84 illustrations.

In magnetism, Gilbert recognizes the magnetic field, the effects of heat, magnetic induction and magnetic screening; but his cardinal discovery is that the earth itself is a great magnet with its magnetic poles, equator and axis. He was led to this generalization by prolonged experiments with globular magnets, or terrellas, on which he poised small magnetic needles, finding that, however placed, they always pointed to the poles. He confirmed his theory by reference to the prevalence of magnetic materials in the crust of the earth, the behavior of the compass-needle and the dip circle, and also by the magnetic condition of vertical masses of iron such as the crosses of church-steeples.

Gilbert was an ardent advocate of the Copernican theory, and there is reason to believe that his magnetic work was undertaken in its defense, convinced as he was that the revolution of the earth round the sun and its suspension in space would follow at once from the magnetic attraction of the other planets provided the earth itself could be proved to be a colossal magnet. Gilbert was belittled in *De Augmentis Scientiarum* by Chancellor Bacon, who was a staunch anti-Copernican, but was praised and admired by Galileo and Kepler. Two translations of 'De Magnete' have been made, the first by P. Fleury Mottelay of New York (1893), and the second by the Gilbert Society of London (1900). Gilbert's work stands out as the second landmark on magnetic philosophy, the first being a treatise on the lodestone by Peregrinus (q.v.) A.D. 1269.

GILBERT, Sir William Schwenck, English dramatist: b. London, 18 Nov. 1836; d. 29 May 1911. He was a clerk in the Privy Council Office 1857–61, and in 1863 was called to the bar. He contributed to the magazines and was on the staff of *Fun,* in whose columns his celebrated 'Bab Ballads' began to appear in 1866. His burlesque 'Dulcamara' (1866) was followed by burlesques, dramas, comedies and fairy comedies. But it is the librettos of the Savoy operas, written with Sir Arthur Sullivan (q.v.) as musical composer, that form his enduring title to fame. The series began with 'Trial by Jury' in 1875, ended with 'The Gondoliers' in 1889, and included 'The Pirates of Penzance,' 'The Mikado' and 'The Yeoman of the Guard'; but a financial dispute with Sullivan and D'Oyly Carte, the producer, brought the series to a close. In his better-known works Gilbert displays a whimsical humor that is often subtle, always healthy in tone, and his peculiar blend of humor with a genial cynicism earned for itself the title "Gilbertian." (See Mikado, The; Patience; Pinafore; Bab Ballads). Consult Fitzgerald, P., 'The Savoy Opera and the Savoyards' (1894).

GILBERT ISLANDS, or KINGSMILL GROUP, a group of 18 islands in the south Pacific Ocean north and south of the equator and lying between long. 172° and 177° E. The area is 166 square miles. They are the most easterly of the groups collectively constituting Micronesia and are of coral formation, all low, the highest land in the group not exceeding 20 feet. The natives resemble the Malays. The whole group came under the protection of Great Britain in 1892, but the islands have a limited self-government. Pop. 26,417 natives, and 446 foreigners.

GILBERTINES, The, a religious order founded about 1130 by Saint Gilbert (1083–1189), a parish priest of Sempringham, Lincolnshire, England. It was the only purely English order ever established prior to the Reformation. In 1147 he also founded a congregation of priests and lay brothers. At the dissolution of the order in the reign of Henry VIII it numbered 22 convents. Consult Berthand, 'Life of Saint Gilbert' (Paris 1892); Graham, 'Saint Gilbert of Sempringham and the Gilbertines' (1901).

GILBOA, a chain of hills in Palestine, between 500 and 600 feet high, overhanging the site of the ancient city of Jezreel and rising between the fertile plan of Esdraelon and the valley of the Jordan. It is memorable as the scene of the defeat and death of King Saul and his three sons at the hands of the Philistines (1 Sam. 31; 2 Sam. i, 6; 1 Chron. x, 1–8).

GILCHRIST, William Wallace, American musician: b. Jersey City, N. J., 1846. He was a pupil of Clarke at the University of Pennsylvania, was an organist in Cincinnati 1872–73 and from that time was in Philadelphia, where he became a member of the faculty of the Musical Academy and a leader of choral societies in Eastern States. His setting of Psalm XLVI for solo voices, chorus, organ and orchestra obtained the prize for composition at the Cincinnati festival of 1882. Two years before he had won the Mendelssohn Glee Club (New York) prize, with the composition 'Autumn Dreaming.' He was conductor of several important Eastern chloral societies and his compositions, particularly for the Church, are very widely known. Other important compositions are 'Song of Thanksgiving,' arranged for chorus and orchestra; a cantata 'The Rose' (1887); the 'Ode to the Sun'; two symphonies in D and C and some chamber music; two big oratorios. He received the degree of Mus.D. from the University of Pennsylvania in 1896.

GILDAS, the earliest British historian. He seems to have been born in the early 6th century. He says that he was born in the same year that the battle of Mount Badon took place, which makes it about 516. From his familiarity with the Bible it is evident that he was of some clerical order and his statement that he used foreign sources indicate that he spent some time on the Continent. According to the 'Cambrian Annals,' he died in 570. His book was written under the title 'Gildæ Sapientis De Excidio et Conquestu Britaniæ'; and has gone through many editions. It is a curious jumble of vague statements and erroneous conclusions and is of little historical value. The period covered begins with the invasion of Britain by the Romans and ends with the author's time. The best edition is by Mommsen in 'Monumenta Germaniæ Historica Auctores Antiquissimi' (Berlin 1894).

GILDER, Jeannette Leonard, American editor: b. Flushing, N. Y., 3 Oct. 1849; d. New York, 17 Jan. 1916. Having entered journalism in 1869, she became editorially connected with *Scribner's Monthly* (the present *Century Magazine*), was a member of the New York *Herald* staff as literary editor and later musical and dramatic editor (1875–80) and in 1881 with her brother, J. B. Gilder (q.v.), founded and became editor of the *Critic,* a monthly review of literature, drama and art. The *Critic* was a pioneer in its field and among its contributors were many notable writers. Using the pen name "Brunswick," Miss Gilder was for many years the New York correspondent of papers in Boston, Chicago, Philadelphia and other American cities. Her articles during this period made her well known as a journalist. She wrote many magazine articles, short stories and plays. At the time of her death she was the editor and proprietor of the *Reader,* a guide for book buyers. She was the editor of 'Essays from the Critic'; 'Representative Poems of Living Poets'; 'Pen Portraits of Literary Women' and 'Authors at Home.' She wrote 'Taken by Siege' (1886–96); 'The Autobiography of a Tomboy' (1900), and 'The Tomboy at Work' (1904). She also dramatized Sienkiewicz's 'Quo Vadis.'

GILDER, Joseph Benson, American journalist: b. Flushing, N. Y., 29 June 1858. After varied experience in journalism he with his sister, J. L. Gilder, established the *Critic*, of which he became an editor. In 1895 he was appointed literary adviser to the Century Company and subsequently literary representative of Dodd, Mead and Company in London. He was later American dispatch agent, London (1902–04); editor of *Putnam's Magazine* (1906–10) and of the New York *Times* 'Review of Books' (1910–11). Since 1914 he has been secretary of the Industrial Finance Corporation. He is also editor of 'The American Idea' (1902); Andrew Carnegie's 'Gospel of Wealth' (1900); John Hays, 'Addresses' (1906); and James Russell Lowell's 'Impressions of Spain' (1899).

GILDER, Richard Watson, American editor and poet: b. Bordentown, N. J., 8 Feb. 1844; d. New York, 18 Nov. 1909. He was a private of artillery during the campaign in Pennsylvania (1863) and later managing editor of the Newark (N. J.) *Advertiser*. He subsequently established, with Newton Crane, the Newark *Register*, was editor of *Hours at Home*, a monthly of New York and when this was merged in *Scribner's Monthly* became managing editor of the latter (1870). In 1881 he succeeded J. G. Holland (q.v.) as editor-in-chief of the *Monthly*, in which capacity he remained after it became the present *Century Magazine*. He was prominently identified with public affairs as chairman of the New York Tenement-House Commission (1894), member of the council of the National Civil Service Reform League and other posts and was a founder of the Authors' Club, the International Copyright League and the Society of American Artists. The best of his verse, most of which originally appeared in magazines, was collected in 'Five Books of Song' (1894). Later volumes are 'In Palestine and Other Poems' (1898), and 'Poems and Inscriptions' (1901). Consult Gilder, R., 'Letters of Richard Watson Gilder' (1916).

GILDER, William Henry, American journalist and Arctic explorer: b. Philadelphia, 16 Aug. 1838; d. 1900. He served in the Civil War and was brevetted a major at its close. He accompanied Lieutenant Schwatka in 1878 on a polar expedition and in 1881 was a member of the Rodgers expedition as a correspondent of the New York *Herald*. His chief works are 'Schwatka's Search' (1881); 'Ice Pack and Tundra' (1883).

GILDERSLEEVE, Basil Lanneau, American classical scholar: b. Charleston, S. C., 23 Oct. 1831. He was graduated at Princeton in 1849 and studied in Germany for several years. He was professor of Greek at the University of Virginia from 1856 to 1876, when he was appointed professor of Greek at Johns Hopkins University. He founded and edited the *American Journal of Philology* and published among other works 'A Latin Grammar' (1867, 1894, 1899); 'Satires of Persius Flaccus' (1875); 'Justin Martyr' (1875); 'Odes of Pindar' (1885); 'Essays and Studies' (1890); 'Hellas and Hesperia' (1909); and, with C. W. E. Miller, 'Syntax of Classical Greek from Homer to Demosthenes' (New York, Part I in 1900 and Part II in 1911).

GILDING, the art of applying and permanently attaching gold leaf or gold dust to surfaces of wood, stone, metals, etc. The Egyptian monuments present numerous traces of the existence of the art in ancient Egypt. The process seems to have been the same with that now used. The Persians also were acquainted with this art as appears from the ruins of Persepolis. The Greeks and Romans employed gilding for many purposes. The Greeks used to gild the hoofs and horns of victims. The practice of gilding statues prevailed in the infancy of the art of sculpture and was never entirely dropped by the ancients. The Romans used to gild sweetmeats and many articles of furniture and utensils which have come down to us are gilt. There are also specimens of gilt glass and metals. The gilding which still remains on some ancient bronze monuments is remarkable for its brilliancy. The ancients carried the practice of gilding to a greater extent than the moderns; they gilded almost all their statues of bronze, wood or plaster and frequently those of marble, the ceilings of rooms and even marble columns. The most remarkable examples of gilding employed with taste and effect in architecture are the ceiling of Saint Peter's and that of Santa Maria Maggiore.

The art of gilding at the present day is performed on metals, or on wood, plaster, leather, parchment, paper, glass, etc. Chemical processes are those which are usually employed for metals. Gilding on copper is performed by the process called wash or water gilding, with an amalgam of gold and mercury. The surface of the copper, being freed from oxide, is covered with the amalgam and afterward exposed to heat till the mercury is driven off, leaving a thin coat of gold. Copper, however, is rather too soft and dark-colored a metal to be treated in this way with advantage. Brass is a very suitable metal for this mode of gilding, but the best of all is a mixture of copper with one-seventh of brass. Copper, brass, etc., are gilded by being attached to wires and plunged into a mixture, where they are allowed to remain as long as the workman thinks necessary, from a few seconds to a minute when the mixture is newly prepared, but longer if it has been used for some time. Gilding is also performed by dipping a linen rag in a saturated solution of gold, and burning it to tinder. The black powder thus obtained is rubbed on the metal to be gilded with a cork dipped in salt water till the gilding appears. Iron or steel is gilded by applying gold leaf to the metal, after the surface has been well cleaned and heated till it has acquired the blue color which at a certain temperature it assumes. Several leaves of gold are thus applied in succession, and the last is burnished down cold. The same process may be applied to copper. The operation of gilding may also be performed on iron and steel by diluting the solution of gold in nitro-hydrochloric acid with alcohol and applying it to a clean surface. A saturated solution of gold in nitro-hydrochloric acid, being mixed with three times its weight of sulphuric ether, dissolves the chloride of gold and the solution is separated from the acid beneath. To gild the steel it is merely necessary, the surface being previously well polished and cleaned, to dip it in the ethereal solution for an instant, and on withdrawing it to wash it instantly by agitation in water. Before being gilded, masonry must be rendered waterproof by means of a solution of shellac and gutta percha in naphtha or some other coating.

Gilding on wood, plaster, leather, parchment or paper is performed by different processes of mechanical gilding. The first of these is oil gilding, in which gold leaf is cemented to the work by means of oil size. In the case of paper or vellum the parts to be gilded receive a coat of gum water or fine size to render them non-absorbent, and the gold leaf is applied before the parts are dry. They are afterward burnished with agate. Lettering and other gilding on bound books are applied without size. The gold leaf is laid on the leather and imprinted with hot brass types. Brass rollers with thin edges are employed in the same way for lines, and similar tools for other ornaments. When the edges of the leaves of books are to be gilded they are first cut smooth in the press, after which a solution of isinglass in spirits is laid on, and the gold leaf is applied when the edges are in a proper state of dryness. Japanner's gilding is another kind of mechanical gilding which is performed in the same way as oil gilding, except that instead of gold leaf a gold dust or powder is employed.

Porcelain and other kinds of earthenware as well as glass may be gilded by mixing a layer of gold in a powdered state by the action of fire. The gold dust or powder required in this operation may be obtained by precipitating it from a solution in aqua regia, either by means of sulphate of iron or protonitrate of mercury. In order that the gold powder may be applied to the surface of the article to be gilded it must be well mixed with some viscous vehicle such as spirits of turpentine mixed with some fatty matter, or strongly gummed water. It is then laid cn with a fine camel's hair brush. When the article to be gilded is made of soft porcelain, delft-ware, or any kind of earthenware with a plumbiferous glazing, nothing else is required than to apply the gold in this manner, and then subject the piece of earthenware to a heat sufficient to soften the glazing, and thus fix the gilding. But in the case of hard porcelain, some kinds of stoneware and other varieties of pottery, in which the glazing does not soften at a suitable temperature, the gold powder, before being mixed with the viscous vehicle by which it is applied, must have a flux added to it, which serves as a means of attachment between the metal and the earthenware. The best flux is oxide of bismuth precipitated by water from a solution of nitric acid, with the addition of one-twelfth part of melted borax. One-tenth or one-fifteenth part of this flux is added for every part of gold contained in the mixture, which is applied to the surface of the earthenware. Heat is applied in the same way as in the previous case to melt the flux, and thus fix the layer of gold to the article. The gilding must finally be burnished in order to bring up the gold color. Another method of gilding these substances is to mix neutral chloride of platinum with rectified spirits of turpentine in such a manner that the chloride is held in suspension in a finely divided state in the turpentine, to apply this liquid to the article to be gilded by means of a brush, and then to subject the article to heat so as to volatilize the spirits of turpentine and leave a uniform layer of platinum affixed to the glass or earthenware. The article, after being cooled, cleaned with aqua fortis and washed with water, is next dipped in a gilding liquid; the gilding is then completed by rubbing the gilt parts with chamois leather. This method of gilding has the advantage of enabling the gilder to dispense with the burnishing, which is a very hazardous operation for fragile articles, and in the case of those which are of a very intricate form or very deeply cut out often impracticable.

It was announced in 1912 that the brothers Marino, Italian chemists, had invented a process whereby metals and metallic alloys can be deposited on other metals, ceramic ware, wood, celluloid and other substances by electric agency. In the case of glass, for example, the surface to be metallically mounted is first subjected to sand blasting, to remove the polish and give the metal a grip. This abrased part is then chemically treated, so that when the article is suspended in the electro-plating bath, the metal, whether it be of gold, silver or any other metal or its alloy, is attached and forms an integral part of the foundation. See METALLURGY.

GILEAD, gil'ę-ạd (rough, rugged, hard), a country on the east side of the Jordan, at one time a portion of the kingdom of Israel. Its exact area is doubtful; but the southern boundary, the river Arnon, and the western boundary, the Jordan River, are well defined. The Yarmuk is given by some as a northern boundary; and some historians mention the country of Gilead as extending to the shores of the sea of Galilee and the plains of Bashan. The eastern boundary was «the desert.» It is a mountainous country traversed by many small streams which flow into the Jordan. All the mountains are mentioned frequently as «mountains of Gilead,» and one peak is called in ancient history, «Mount of Gilead.» This peak is thought to be the one now known as Jebel or Djabal (mount) Osha. The soil is fertile and the vegetation generally luxuriant and the region is well wooded and well watered. The low round mountains or hills are no hindrance to cultivation as practised by the native inhabitants. A considerable portion is devoted to pasturage and large herds of cattle and flocks of sheep graze on the hillsides and table-lands as in the times mentioned in the Old Testament. The true balm of Gilead was a product of the *Balsamodendron gileadense*, now quite extinct in Palestine, but still cultivated about Mecca. It was probably a native of East Africa. The terebinth tree and the oak still flourish in Gilead, especially in the valley of the Jabbok.

Gilead is mentioned frequently in the Bible. Much of its history before the birth of Christ is given in the Old Testament. In Deuteronomy and Numbers may be found an account of the conquest of the country and the transfer of a part Reuben and Gad. In Judges and Kings is a record of the wars waged upon Gilead by the Syrians, the Midianites and the Ammonites, and finally the victory of the Assyrians. The flight of Absalom is given in 2 Sam. xiii. In 1 Sam. xxi is an account of the battle in which the sons of Saul were slain, and of Saul's own death. It is there told that "the valiant men of Jabesh-Gilead arose and went all night, and took the body of Saul and the bodies of his sons from the wall of Beth-Shan," and burned them according to the custom of the times. And afterward these "valiant men" fasted several days. The chief cities of Gilead were Jazer, Mizpeh, Mahanaim, Penuel and Succoth. Consult Oliphant, Lawrence, 'The Land of Gilead' (London 1880).

GILES, jīlz, **Saint (Saint Aegidius)**, a native of Greece, who, according to legend, lived in the 7th century. He gave all his property to the poor, and went to France, where he lived in solitude for many years. Finally he permitted companions in his retreat, and founded a house of the Benedictine order. A town grew up around it, and was called Saint Giles. The saint is the patron of many churches in France, Germany, Scotland and Poland.

GILES, William Branch, American politician: b. Amelia County, Va., 12 Aug. 1762; d. Albemarle County, Va., 4 Dec. 1830. He was educated at Hampden-Sidney College and at Princeton, studied law and practised at Petersburg, was a member of the Federal House of Representatives in 1790–98 and 1801–02, and of the Senate in 1804–15. In 1827–30 he was governor of Virginia. Originally a Federalist, he later became a Republican, and was the leader of his party in the Senate 1804–11. He took a prominent part in the Virginia Constitutional Convention of 1829–30. He was an effective speaker, assertive in methods and frequently broke with his party, in which he finally lost influence. His 'Political Letters to the People of Virginia' appeared in 1813.

GILES, Saint (Saint Giles in the Fields), a parish in London in the metropolitan borough of Holborn, a mile to the northwest of Saint Paul's. The church is in classical style, and contains the remains of Chapman, Shirley, Marvell, Lord Herbert of Cherbury and Sir Roger L'Estrange. One district of it, by its poverty and wretchedness, long formed a very striking contrast to the west end of the metropolis, so that Saint Giles and Saint James were spoken of as typical of wretchedness and luxury, respectively. There is another London church of Saint Giles, called Saint Giles Cripplegate, which contains the tomb of Milton.

GILFILLAN, George, Scottish writer: b. Comrie, Perthshire, 30 Jan. 1813; d. 13 Aug. 1878. He received his education at Glasgow University, studied theology at The Divinity Hall of the Secession Body and was ordained in 1836. He accepted a pastorate at the School Wynd Church, Dundee, where he remained until his death. His first publication was a volume of sermons (1839), followed by 'Gallery of Literary Portraits' (1846), and a second and third 'gallery.' 'The Bards of the Bible' (1851) proved to be the best of his works. He wrote also 'The Martyrs of the Scottish Covenant' (1852), a 'History of Man.' and an edition of the 'British Poets.' He was most popular as a lecturer and preacher.

GILGAL, gil'găl, the name of several ancient towns near the Jordan, where the Israelites passed the river into Canaan, where they were circumcised and held the first Passover after leaving the desert (Joshua iv, 19). Here rested the tabernacle, till removed to Shiloh; here Samuel held court as judge of Israel, and here Saul was crowned. It is frequently mentioned in the Bible; a school of the prophets was established here (2 Kings iv, 38), yet it afterward became a seat of heathen worship (Amos iv, 4). Josephus places one of the towns within two miles of Jericho, but no traces of it are at this day extant.

GILGAMESH EPIC, the story of the traditional hero of Babylonia, found in the library of Ashurbanabal. It originally included 12 tablets and 3,000 lines, about half of which are now available. The name of the hero was at first rendered "Izdubar," until a key was discovered by Pinches which indicated that "Gilgamesh" was the proper equivalent. The story has as its basis a mingling of mythological matter with historical tradition, just as one finds in various national epics. Gilgamesh is evidently regarded as a demigod and as a great ruler at the same time. The scene of the story centres about the city of Uruk or Erech in Babylonia. The first tablet describes various misfortunes which have fallen on the city. In the second, Gilgamesh comes forward as the hero into whose hands the place has fallen. To resist his ruthless treatment, the goddess Aruru, the creator of the hero, is appealed to to create a creature to resist the mighty conqueror. Accordingly, Eabani, a wild man, is made. But Gilgamesh, by the use of Ukhat, a courtesan, succeeds in winning over Eabani, who becomes his valuable assistant in all of his enterprises, chronicled in the third and fourth tablets. They conduct a campaign against Khumbaba, and succeed in capturing the wonderful grove there. Very little of the fifth tablet has been preserved, but in the sixth, a new phase is developed. The wily goddess, Ishtar, the "creator" goddess, who has become notorious for destroying those whom she has made to love her, endeavors to induce Gilgamesh to wed her. This he refuses, and for this insult loses his chance for immortality. Ishtar, angered, seeks the aid of her father, Anu, the ruler of heaven, in gaining retribution. Anu creates a huge bull to destroy Gilgamesh, but this plot is unsuccessful. Eabani and the hero vanquish the bull, and his horns are sent to Lugal-Marada, the patron of the hero, amid general rejoicing. However, here the climax of the hero's glory is reached. A grave calamity befalls him in the death of Eabani, and his great strength begins to decline. Fearing lest the same disease destroy him also, Gilgamesh goes forth in search of Parnaphistim, son of Kidin Marduk, to seek the gift of immortality. The way to the god lies first through a vast desert, inhabited by scorpion men, and thence across a mighty sea, guarded by the goddess Sabitum, who refuses Gilgamesh passage, except on the condition that he gain the guidance of Ardi-Ea, the ferryman of Parnaphishtim. Gilgamesh is successful in securing the services of the boatman and together they come to the dwelling-place of the immortal god. Here, however, the hero is told that no mortal may escape death, and though sympathy is offered, nothing is accomplished. The long story of how Parnaphistim gained immortality is interposed at this point, in answer to the queries of Gilgamesh. At the advice of Ea, Parnaphistim escaped a dangerous flood by building a houseboat for himself and his family, and when the storm ceased, Bel, who was the author of it, endowed Parnaphistim and his family with immorality, permitting him to live forever at the confluence of the four rivers, where lay the traditional Paradise of the Babylonians and Hebrews. The parallel between this storm story and the narrative of the deluge in the Hebrew Bible is obvious. Probably both were derived independently from separate interpretations of the narrative of the destruction of a great city or district. The wife of Parnaphistim prepares, at her husband's bidding, a magic food which partly cures Gilgamesh of his disease; and then, after bathing in the waters of the fountain of life, he finds himself completely restored. Before he sets out to return to his native land, the hero is informed of a certain thistle-like plant which will restore his youth. His search for this is successful; but just as he is about to take possession of the wonder-working herb, an evil demon disguised as a serpent steals it from him. He returns to his native city, weary and penitent,— and thus the eleventh book ends.

The twelfth book deals with the search of Gilgamesh for knowledge of the life hereafter. He calls upon Eabani to reveal the secret to him, and, with the consent of the god Nergal, is granted an interview with his lost companion. Eabani describes the gloomy abode of the afterworld, and tells of the various futures that await the dead, according to the manner of their ends. With this picture, the entire epic is brought to a close.

In this story, one finds a curious blending of the philosophy, history, mythology and religion of ancient Babylonia. In frequent recountings of the tale, doubtless new stories and interpretations were interspersed, until it reached the form in which it has come down to us. Allegorically, the whole poem takes on the aspect of the mystical life of man — his search for the secrets of life, death and immortality. Created by the gods, he acquires for his assistance crude force and power, by means of which he is able to conquer his enemies and establish his greatness. But this strength leaves him, and he is left diseased and destitute. Of disease he is able to cure himself; but then, he finds himself face to face with the inevitability of death, gloomy and terrible in its outlook.

To what extent the Gilgamesh epic influenced the story of Nimrod in the Hebrew Bible is difficult to determine, though comparisons are profitable in revealing similarities. It is interesting to note also that the exploits of Hercules in the Greek legends had several points in common with those of Gilgamesh; and that in the legendary career of Alexander the Great, several incidents in the life of the Babylonian hero are incorporated. Consult Haupt, Paul, 'Das Babylonische Nimrodepos' (Leipzig 1884–91); Sauveplane, F., 'Une Epopée Babylonienne, Ishtubar-Gilgames' (Paris 1894); Jastrow, 'Religion of Babylonia and Assyria' (Boston 1898); Sayce, 'The Religions of Ancient Egypt and Babylonia' (Edinburgh 1903); Meissner, B., 'Alexander and Gilgamos' (Leipzig 1894).

Rose Boochever,
Editorial Staff of The Americana.

GILL, gil, Sir David, Scottish astronomer: b. Aberdeen, 12 June 1843; d. 24 Jan. 1914. He was chief of staff of the private observatory of Lord Lindsay (afterward the Earl of Crawford) at Dunacht, founded in 1870; in charge of Lindsay's expedition to Mauritius in 1874 to observe the transit of Venus and the opposition of Juno, by means of the heliometer, for the determination of the solar parallax. He determined the longitudes of Malta, Alexandria, Suez, Aden, Bombay, Seychelles, Reunion, Mauritius and Rodriguez by cable and chronometers, and measured the first base-line for the Egyptian triangulation at the request of the khedive. In 1877 he was in charge of the expedition to Ascension to observe the opposition of Mars for parallax; and was director of the observatory at Cape of Good Hope, 1879 to 1907. In 1896 he originated and carried through the geodetic survey of Natal and Cape Colony and in the following year that of Rhodesia. He introduced the cataloguing of the stars by the aid of photography. He contributed largely to the literature of astronomy, and was the author of the 'History of the Royal Observatory, Cape of Good Hope' (1913).

GILL, John, Baptist minister: b. Kettering, Northamptonshire, 23 Nov. 1697; d. Camberwell, 14 Oct. 1771. He was practically self-educated, and at the age of 19 began to preach. His first regular pastorate was at the Baptist congregation at Horsleydown in Southwark. Here he remained from 1719 to 1757, when he became pastor at a chapel near London Bridge. He lectured at Great Eastcheat also from 1729–56. The University of Aberdeen awarded him the degree of D.D. in 1748. His works include 'Exposition of the Song of Solomon' (1728); 'The Prophecies of the Old Testament Respecting the Messiah' (1728); 'The Doctrine of the Trinity' (1731); 'The Cause of God and Truth' (4 vols., 1731); 'Exposition of the Bible' (10 vols., 1746–66). He left a fine collection of Hebrew and Rabbinical literature, and on the subject of the Hebrew language wrote 'The Antiquity of the Hebrew Language — Letters, Vowel Points and Accents' (1767). Other works are 'A Body of Doctrinal Divinity' (1767); 'A Boody of Practical Divinity' (1770); and 'Sermons and Tracts' (1773). Consult the memoir by Rippon (London 1816).

GILL, Theodore Nicholas, American educator: b. New York, 21 March 1837; d. 1914. He became professor of zoology in Columbian (now George Washington) University in 1884. His publications include 'Synopsis of Fresh Water Fishes' (1861); 'Arrangement of the Families of Mollusks' (1871); 'Catalogue of the Fishes of the East Coast of North America' (1873); 'Bibliography of the Fishes of the Pacific Coast of the United States to the End of 1879' (1882); 'Principles of Zoogeography' (1884); 'The Characteristics of the Family of Scatophagoid Fishes' (1891); 'Notes on the Tetradontoidea' (1892); 'Parental Care among Fresh Water Fishes' (1906); and, with Elliott Coues, 'Material for a Bibliography of North American Mammals' (1877).

GILL NET, a net suspended vertically, by means of floats, and leaden weights, in standing or running water, fresh or salt. It has meshes which allow the head of the fish to pass, but are too small for the body beyond the gills to get through, and when the captive tries to draw back, catch in the gills, from which no effort can disentangle them.

GILLEM, Alvan Cullem, American soldier: b. Jackson County, Tenn., 1830; d. near Nashville, Tenn., 2 Dec. 1875. He was graduated from the United States Military Academy in 1851, served in the Seminole War (1851–52), in the Civil War became brevet colonel, United States army, and brigadier-general of volunteers, and upon the reorganization of the State government of Tennessee was vice-president of the convention for revision of the constitution and a member of the first legislature of the new régime. In 1867–68 he commanded the district of Mississippi. He attained the rank of colonel and brevet major-general in the regular service.

GILLENIA, jĭ-lē'nĭ-ą, or **PORTERANTHUS,** a North American perennial genus of *Rosaceæ,* closely allied to *Spiræa,* embracing only two known species; also called Indian physic, bowman's root and American ipecac. See BOWMAN'S ROOT.

GILLESPIE, gĭ-lĕs'pĭ, **Eliza Maria,** American philanthropist: b. near West Brownsville, Washington County, Pa., 21 Feb. 1824; d. Notre Dame, Ind., 4 March 1887. In 1853 she became a member of the congregation of the Holy Cross, and after a novitiate in France was appointed in 1855 superior of the Saint Mary's Academy, Bertrand, Mich. She later transferred the academy to its present location, Saint Mary's, Ind., and established nearly 30 similar institutions in the United States. During the Civil War she directed from Cairo, Ill., an important hospital work for Federal soldiers. Upon the separation of the congregation of the Holy Cross in the United States from the order in Europe she was for two terms superior.

GILLESPIE, George de Normandie, American Protestant Episcopal bishop: b. Goshen, N. Y., 15 June 1819; d. Grand Rapids, Mich., 19 March 1909. He was graduated from the General Theological Seminary in New York in 1840, entered the ministry and held rectorates at Leroy, N. Y.; Cincinnati, Ohio; Palmyra, N. Y., and Ann Arbor, Mich. In 1875 he was consecrated bishop of Western Michigan. He published many religious works.

GILLETT, Ezra Hall, American clergyman and educator: b. Colchester, Conn., 15 July 1823; d. New York, 2 Sept. 1875. He was graduated at Yale College in 1841 and from Union Theological Seminary in 1844. For the next 25 years he was pastor of a Presbyterian church in Harlem, New York city. In 1868 he became professor of ethics, political economy and history in New York University and served until his death. His extensive library containing a very complete collection on the Deistic Controversy is the property of Union Theological Seminary. He was the author of many articles contributed to the theological reviews, and author of 'The Life and Times of John Huss' (2 vols., 1861); 'Life Lessons in the School of Christian Duty' (1864); 'History of the Presbyterian Church in the United States' (2 vols., 1864); 'England Two-hundred Years Ago' (1866); 'What Then, or the Soul's Tomorrow' (1866); 'Ancient Cities and Empires: Their Prophetic Doom' (1867); and an authoritative work on the Deistic Controversy — 'God in Human Thought' (2 vols., 1874); 'The Moral System' (1874).

GILLETTE, William, American actor and playwright: b. Hartford, Conn., 24 July 1855. He took special courses of study at the University of New York, Massachusetts Institute of Technology and the University of Boston while playing in stock companies. From 1877 devoted himself zealously to work on the stage, playing with different stock companies in New Orleans, Boston, New York and other cities. He has since then acted important parts in many of his own plays. Among his best-known productions are 'The Professor' (1881); 'Esmeralda' (1881), with Mrs. F. H. Burnett; 'The Private Secretary'; 'Held by the Enemy' (1886); 'A Legal Wreck' (1888); 'Too Much Johnson' (1895); 'Secret Service' (1896); and 'Sherlock Holmes' (1899).

GILLIS, gĭl'ĭs, **James Melvin,** American astronomer: b. Georgetown, D. C., 6 Sept. 1811; d. Washington, D. C., 9 Feb. 1865. He entered the navy in 1827, soon obtained leave of absence and was graduated at the University of Virginia, and then spent six months in study in Paris. He was in charge of the observation of occultations and transit observations made in connection with the Wilkes exploring expedition, Gillis making the observations at the Washington end at a little observatory on Capitol Hill. He had charge of the United States astronomical expedition to the southern hemisphere, and in 1861 was appointed superintendent of the national observatory at Washington, D. C. He published 'Astronomical Observations' (1846); 'Report of the United States Astronomical Expedition of 1849–52' (1855).

GILLIS LAND, an Arctic region north of Spitzbergen, first sighted in 1707 by Gillis, a Dutchman, in lat. 81° 30' N. and long. 36° E., but not visited by him. Some geographers identify it with King Charles or Wiche Land, one of the Spitzbergen group.

GILLMAN, Henry, American botanist: b. Kinsale, Ireland, 16 Nov. 1833; d. Detroit, Mich., 30 July 1915. He settled in Detroit, Mich., in 1850; and was United States consul at Jerusalem in 1886–91. During his consulate he so strongly opposed the Turkish government in its expulsion of Jews from Palestine that several European countries supported him, and the exclusion laws were modified. He is best remembered for his researches in archæology and botany and his procurement and publication of photographic facsimiles of texts of early Christian MSS., including the Didache. He published 'The Wild Flowers and Gardens of Jerusalem and Palestine' (1894); 'Hassan' (1896); 'Vericourt Westhrop and Issue' (1903); also many scientific and other papers, including 'The Ancient Men of the Great Lakes'; 'Is a Variety an Incipient Species?'; 'Adonis in Livery'; 'Under the Sign Taurus'; 'Gilbert Jervis,' etc.

GILLMORE, Quincy Adams, American military officer: b. Black River, Lorain County, Ohio, 28 Feb. 1825; d. Brooklyn, N. Y., 7 April 1888. He was graduated at West Point in 1849; promoted captain in 1861, and brigadier-general of volunteers in 1862. He displayed skill as an engineer by the capture of Fort Pulaski in April 1862, and was appointed commander of the Department of the South in June 1863. He made a successful attack on Morris Island in July 1863, began to bombard Fort Sumter and Charleston in August, and took Fort Wagner in September; Fort Sumter was reduced to a ruinous condition, but its garrison continued to hold it till 17 Feb. 1865. General Gillmore commanded the Tenth corps near Richmond in 1864, and was brevetted major-general, United States army, in 1865.

GILLOTT, jĭl'ŏt, **Joseph**, English manufacturer: b. Sheffield, 11 Oct. 1799; d. Birmingham, 6 Jan. 1872. He shares with Sir Josiah Mason the credit of having brought the manufacture of steel pens to its present state of high perfection.

GILLS, the breathing organs of fishes, larval amphibians, crustaceans and certain other aquatic animals. See *Respiratory System*, in article ANATOMY, COMPARATIVE; also FISH.

GILLYFLOWER, a popular English name for some of the cruciferous plants most prized for the beauty and fragrance of their flowers, as the wallflowers and stocks; also for *Hesperis matronalis*, dame's rocket or dame's violet (q.v.). The name gillyflower has been regarded as a corruption of July-flower; but in Chaucer it appears in the form *gilofre;* and the French *giroflée* indicates the true derivation from *girofle*, a clove, the smell of the clove-gillyflower, or clove-pink, having suggested the name of that flower.

GILMAN, Arthur, American educator: b. Alton, Ill., 22 June 1837; d. 28 Dec. 1910. He was engaged in banking in New York 1857–62, when he removed to Lenox, Mass., and devoted himself to literary and educational work until he went to Cambridge in 1870. He was the originator (1876) of the Harvard Annex, of which he became executive officer, and, upon its organization as Radcliffe College, regent. In 1886 he founded and became director of the Cambridge school for girls, known as the Gilman School. He edited Chaucer's works (1879) and other collections, collaborated in several volumes of the 'Stories of the Nations' series, and wrote a number of educational works, chiefly historical in character, such as 'The Story of Rome' (1886); 'The Colonization of America' (1887).

GILMAN, Caroline Howard, American author: b. Boston, 8 Oct. 1794; d. Washington, D. C., 15 Sept. 1888. In 1819 she was married to the Rev. Samuel Gilman (q.v.) and removed with him to Charleston, S. C., where she began to edit in 1832 the *Rosebud*, a juvenile weekly newspaper, which subsequently took the name of the *Southern Rose*, and contained articles of much literary merit. From this periodical she reprinted at different times the 'Recollections of a New England Housekeeper' (1835); 'Recollections of a Southern Matron' (1836); 'Ruth Raymond, or Love's Progress'; 'Poetry of Traveling in the United States'; 'Verses of a Lifetime'; 'Mrs. Gilman's Gift Book'; and other volumes. The first two of these works attracted particular attention by their practical lessons as well as their genial simplicity and humor, and passed through many editions. She was especially successful, also, in her books for children.

GILMAN, Charlotte Perkins Stetson, American lecturer and writer: b. Hartford, Conn., 1860. She is a daughter of Frederic Beecher and was married to G. H. Gilman in 1900. She is a prominent advocate of equality for women and has published 'Woman and Economics' (1898); 'In This Our World,' a book of verse (1898); 'The Yellow Wall Paper' (1899); 'Concerning Children' (1900); 'What Diantha Did' (1910); 'The Man-Made World' (1910); 'The Crux' (1911); 'Moving the Mountain' (1911).

GILMAN, Daniel Coit, American educator: b. Norwich, Conn., 6 July 1831; d. there, 13 Oct. 1908. He was graduated at Yale College in 1852; was professor of physical and political geography in Yale in 1856–72; and president of the University of California 1872–75. When Johns Hopkins University was founded in Baltimore, Md., in 1875, he was elected its first president and served in that capacity till 1901, when he resigned. In 1896–97 he was a member of the commission to settle the boundary line between Venezuela and British Guiana, and in the latter year also served on the commission to draft a new charter for Baltimore. He was president of the American Oriental Society 1893–1906, and vice-president of the Archæological Institute of America, executive officer of the Maryland Geological Survey and president of the National Civil Service Reform League from 1901 to 1907. He wrote 'Life of James Monroe' (1883); 'University Problems' (1898); Introduction to DeTocqueville's 'Democracy in America'; 'Life of James Dwight Dana,' etc.

GILMAN, John Taylor, American statesman: b. Exeter, N. H., 19 Dec. 1759; d. there, 31 Aug. 1828. In 1775, on the morning after the news of the battle at Lexington and Concord reached Exeter, he marched with 100 other volunteers to Cambridge, Mass., where he served in the provincial army. In 1782 and 1783 he was a member of the Continental Congress, and in 1797 he was chosen governor of New Hampshire, and was annually re-elected for 10 successive years. In 1813–14–15 he was again elected governor, after which he declined to be a candidate. He was a zealous Federalist, and his popularity in New Hampshire was so great that he was frequently chosen governor when his party was in the minority.

GILMAN, Nicholas, American statesman: b. Exeter, N. H., 3 Aug. 1755; d. Philadelphia, 2 May 1814. He was a brother of J. T. Gilman (q.v.) and like him served in the Continental army during the War of the Revolution. He represented New Hampshire in Congress in 1786, and again 1789–97, and was a United States senator 1805–14. He was one of the framers of the Constitution of the United States.

GILMAN, Samuel, American clergyman and author: b. Gloucester, Mass., 1791; d. 1858. He was educated at Harvard University, where he was graduated in 1811. Eight years later he was made pastor of a Unitarian church in Charleston, S. C. He continued in this post until his death; was a great promoter of temperance and an excellent pulpit orator. He married Caroline Howard, daughter of Samuel Howard. His published works are 'Memoirs of a New England Village Choir' (1829);

'Pleasures and Pains of a Student's Life' (1852); 'Contributions to Literature, Descriptive, Critical, Humorous, Biographical, Philosophical and Poetical' (1856); also translations from Boileau and articles in periodicals.

GILMER, Jeremy Francis, American soldier: b. Guilford County, N. C., 23 Feb. 1818; d. 1 Dec. 1883. He was graduated at West Point and entered the engineer corps of the United States in 1839. At the opening of the Civil War he resigned his captain's commission and entered the Confederate service, becoming major-general in 1863.

GILMOR, Harry, American soldier: b. Baltimore County, Md., 24 Jan. 1838; d. Baltimore, 4 March 1883. He entered the Confederate army at the beginning of the Civil War, became known for his exploits as scout, in 1863 raised a battalion of horse of which he was made major, and later in that year, in command of the First Maryland Confederate regiment, captured Frederick, Md., and Chambersburg, Carlisle and Gettysburg, Pa. In 1864 he led Early's advance into Maryland. He was elected Baltimore's police commissioner in 1874, and wrote 'Four Years in the Saddle' (1866).

GILMORE, James Roberts (EDMUND KIRKE), American editor and writer: b. Boston, Mass., 10 Sept. 1822; d. 1903. He was at first in mercantile life, subsequently entering journalism and literature, and his earlier works were written under the pseudonym, «Edmund Kirke.» He wrote 'Among the Pines' (1862); 'My Southern Friends' (1862); 'Down in Tennessee' (1863); 'Life of Garfield'; 'Among the Guerrillas'; 'Adrift in Dixie' (1863); 'On the Border'; 'Patriot Boys'; 'The Rear-Guard of the Revolution'; 'John Sevier as a Commonwealth Builder'; 'The Advance-Guard of Western Civilization' (1888); 'Personal Recollections of Abraham Lincoln and the Civil War' (1898), etc.

GILMORE, Joseph Albree, American politician: b. Weston, Vt., 10 June 1811; d. Concord, N. H., 17 April 1867. He became superintendent of various New Hampshire railway lines, was elected to the State senate in 1858 and re-elected in 1859. In 1863 he was elected governor by the legislature, and in 1864 re-elected by popular vote. His energy increased the troops furnished by New Hampshire to the Federal armies from 15,500 to 33,258.

GILMORE, Patrick Sarsfield, American musical conductor: b. near Dublin, Ireland, 25 Dec. 1829; d. Saint Louis, Mo., 24 Sept. 1892. He went to Boston at 18 and the next year organized Gilmore's band. In 1869 he arranged the Peace Jubilee in Boston, and in 1872 the World's Jubilee, in Boston also. Later he formed the noted 22d Regiment band in New York, which gave concerts in the United States and made a European concert tour in 1882. He composed but little; an anthem entitled 'Columbia,' intended to serve as the country's national hymn, was his only work of note.

GILMOUR, Richard, American Roman Catholic prelate: b. Glasgow, Scotland, 28 Sept. 1824; d. Saint Augustine, Fla., 13 April 1891. He was ordained priest in 1852, and after various pastorates, including those at Portsmouth, Ironton, Cincinnati and Dayton, was consecrated bishop of Cleveland in 1872. His administration of the diocese was markedly efficient, and particularly so along the lines of Roman Catholic education. He published a 'Bible History' (1869); a series of 'Catholic National Readers,' and other books, and in 1874 founded the *Catholic Universe*, an influential journal.

GILOLO, jē-lō-lō, **JILOLO** or **HALMAHERA,** an island of the Molucca group in the Indian Archipelago, belonging to the Netherlands; area 6,500 square miles; length 225 miles. It is of singular form, consisting of four peninsulas, radiating from a common centre, and having large bays between. It is rugged and mountainous, the mountains being volcanic. The original inhabitants have been gradually pressed into the interior by the Malays. Pop. 120,000.

GILPIN, Bernard, English clergyman, known as the «Apostle of the North»: b. Kentmere, Westmoreland, 1517; d. Houghton-le-Spring, 4 March 1583. After studying at Queen's College, Oxford, where he was elected Fellow, he was ordained in 1542. Subsequently he became student of Christ Church. The Reformation soon assumed great importance at Oxford, and Gilpin at first reacted unfavorably toward it, but later was partly won over. In 1552, he was given the vicarage of Norton and obtained a license to preach throughout the kingdom during the lifetime of Edward VI. When Mary succeeded to the throne, Gilpin left England and spent several years at Louvain and Paris, pursuing further religious studies. On his return to England, he was given the vicarage of Easington and the archdeaconry of Durham by his uncle, Bishop Tunstall of Durham, who also protected him against the enemies who attacked him on the ground of his severe criticism of the clergy. He was reported to Bonner, bishop of London, and prepared to give himself up. An accident delayed his journey, and in the meantime, Elizabeth ascended the throne. Gilpin returned to Houghton-le-Spring, where he remained as rector for the rest of his life. Here he became known for his lavish benevolence and charity, his wisdom as a judge, his fearlessness and great goodness. He was active in promoting education, built and endowed a grammar school at his own expense; maintained scholarships for poorer children; sent many of the more promising students to the university; and actually boarded some of them at his own house. He made frequent journeys to the neglected counties of Northumberland, Yorkshire, Cheshire and Cumberland, constantly stimulating and encouraging the work of the clergy there. During his frequent absences, he provided for his own parish by supporting an assistant. As for his position in the religious controversies of the day, it was peculiar to himself. He accepted none of the reformed systems in entirety, although he tolerated various liberal theories. Consult the life by George Carleton, in Bates's 'Vitæ selectorum aliquot virorum' (London 1861). It was translated by William Freake (London 1629; reprinted, Glasgow 1852).

GILPIN, gĭl'pĭn, **Henry Dilwood,** American lawyer: b. Lancaster, England, 14 April 1801; d. Philadelphia, 29 Jan. 1860. He was graduated from the University of Pennsylvania, studied law and became State attorney in 1822. He was

United States attorney for Pennsylvania in 1832, and Attorney-General of the United States 1840–41. Besides 'Reports of Cases' he published 'Opinions of the Attorney-Generals of the United States from the Beginning of the Government to 1841' (1841) and edited 'The Papers of James Madison' (1840); translated Chaptal's 'Essay on Import Duties and Prohibitions' (1841); and published 'Life of Martin Van Buren' (1844). Consult 'Memorial of Henry Dilwood Gilpin' by his wife (Philadelphia 1860).

GILPIN, John, the hero of a well-known ballad by William Cowper. See JOHN GILPIN.

GILPIN, William, American soldier, pioneer and public official: b. 4 Oct. 1822; d. 19 Jan. 1894. He received his early education in England, returned to America and was graduated at the University of Pennsylvania. In 1836 he was graduated at the West Point Military Academy and in 1838 took part in the Florida War. At its close he resigned and for about a year conducted the *Missouri Argus* at Saint Louis. He became secretary of the Missouri general assembly, was admitted to the bar, and established his practice at Independence, Mo. He went to Oregon City in 1843 and organized a provincial government there. On the outbreak of the war with Mexico he was chosen major of the First Missouri Volunteers. In 1860 he was one of the few Southerners who voted for Lincoln, and prior to the latter's inauguration Mr. Gilpin was one of 100 who formed the personal guard of the President-elect. Lincoln appointed him governor of Colorado and it was largely through the new governor's efforts that Colorado was saved from secession. He published 'The Central Gold Region' (1860); 'Notes on Colorado' (1870); 'The Mission of the North American People' (1874) and 'The Cosmopolitan Railway, Compacting and Fusing Together all the World's Continents' (1891).

GILSONITE, gil'sŏn-īt, also called **UINTAHITE,** a natural hydrocarbon compound; a pure hard variety of asphaltum. It is very brittle, a lustrous black in color and fuses. It is used for a great variety of purposes in the arts, for instance in the manufacture of varnishes. Mixed with heavy California maltha or with petroleum residuum it has been used as a paving cement. The principal deposits in the United States are near Soldiers' Summit in Uintah County, Utah. The total output in 1902 was 4,052 short tons, valued at $61,182. The total output of gilsonite and the closely related bitumen Wurtzilite (Elaterite) in 1916 was 26,870 short tons valued at $629,640.

GILTHEAD, or **GILTEYE,** English names for a small and beautiful sea-bream (*Chrysophrys aurata*), with conspicuous gold-colored spots over the eyes. It abounds in the Mediterranean, and ranges northward to England and southward to the Cape of Good Hope. This was one of the fishes kept and fattened by the Romans in their vivaria. Several other species are known in the Far East, one species (*C. berda*), being one of the favorite fishes of Madras under the name of black rock-cod.

GIN (more properly GENEVA, from Fr. *genièvre,* "juniper"), a compounded spirit, prepared by redistilling plain spirit with juniper berries, coriander seeds, angelica root, etc., or by adding various essential oils to rectified spirit. The gin produced by distilling possesses a much more delicate flavor than that produced by mixing or compounding. The strength of gin varies from proof to 50 under proof. It was first made in Holland, notably at Schiedam.

GIN. As used in machinery, gin is an abbreviation of engine and is used of Whitney's device for separating cotton-seed from the fibre, and more generally of a portable hoisting machine whose frame is a tripod, one leg being movable so as to vary its angle of elevation, and thus determine the height of the apex. The other two legs preserve their relative distance and form standards for the drum, round which the rope is wound by power applied to the handspikes. For heavy weights a fall and tackle is used; and for hoisting a bucket from a well or mine, simply a couple of pulleys to change the direction of motion of the rope. One pulley is suspended from the apex, and the other attached between the two permanent legs, so as to change the rope to a horizontal position, for the attachment of a draught horse.

GIN, Cotton. See COTTON; COTTON MACHINERY.

GINATILAN, hē-nä-tē'län, Philippines, a town on the western coast of Cebu, at the mouth of the Rio Ginatilan. There is valuable timber in the vicinity.

GINEVRA, gĭ-nev'ra, or jē-nĕv'ra, the title of a noted narrative poem by Samuel Rogers. It is named for its heroine whose affecting story is also recounted in 'The Mistletoe Bough,' a ballad by Thomas Haynes Bayly.

GINGAL. See JINGAL.

GINGER, in botany, *Zingiber officinale,* common or narrow-leaved ginger, and in ordinary language the rhizomes of the same plant, which has subsessile linear-lanceolate smooth leaves, oblong spikes, acute bracts and a three-lobed lip. It is a native of India, but is cultivated in most tropical countries. A broad-leaved ginger, *Z. serumbet,* also a native of India, is used externally for cataplasms and fomentations, but is not eaten. The pieces or races of the rootstocks are usually from two to four inches long, branched, flat and of a pale buff color. Ginger is known in commerce under two forms, coated and uncoated or scraped; the latter is deprived of its epidermis when in the green state, and sold as white ginger. The chief varieties imported into the United States are Jamaica, Cochin, Bengal, Japan and African. The first three are scraped gingers, and of these Jamaica is the most esteemed owing to its color and flavor. Ginger is an agreeable aromatic, and a valuable stomachic; but is more largely used as a condiment than as a medicine. Preserved ginger, imported from China in jars, consists of the young rhizomes boiled in syrup. Ground ginger is frequently adulterated with sago flour, wheat flour, ground rice and arrowroot.

GINGER ALE or **BEER,** an effervescent drink, made of ginger, water, sugar, cream of tartar (or lemon juice), etc. A well-known method is by pouring a gallon of boiling water over three-fourths pounds of loaf-sugar, one and one-fourth ounces of sliced ginger and the peel of one lemon, and after allowing the mixture to cool till it is milk-warm adding the juice of a lemon and a spoonful of yeast.

GINGERBREAD TREE. See DOOM PALM.

GINGHAM (*ali, gingamo,* from Guingamp, a town in Brittany, where the fabric was woven), a kind of cotton, the manufacture of which was introduced into Great Britain through France from India. It is distinguished from calico by having the colors woven in with the fabric, not printed on it. The patterns are various; sometimes fancy designs, sometimes checkered, and sometimes striped.

GINGILI (jĭn'jĭ-lĭ) **OIL,** a name often given to the bland fixed oil obtained by expression from the seeds of *Sesamun Indicum.* It is used medicinally as laxative or mild purgative. See SESAME.

GINGILLINO, jin-jĭl-lē'nō. In the literary movement which preceded and prepared the uprising of 1848 in Italy,— a movement characterized by the political writings of Gioberti, Balbo and d'Azeglio, by the inspiring pamphlets of Giuseppe Mazzini, an important place must be made for the Tuscan satirical poet, Giuseppe Giusti. In 'Gingillino', composed at Pescia in the spring of 1845, Giusti gives us a masterpiece of satire in his own special field, a genre picture of the abuses of his times.

As the poet states in his «Correspondence,» 'Gingillino' was written «to show by what paths and through what sort of apprenticeship government posts could be reached» in Tuscany. The name «Gingillino» has since become synonymous in Italy of the man who to seek advancement utilizes every cunning art of hypocrisy and pandering. Written at a time when political conditions throughout Italy were at a low ebb, when the oppressive hand of Austrian and Bourbon princelings lay heavily over the country, 'Gingillino' reflects in biting satire the stagnant enervation in Tuscany under the reign of the Grand Duke Leopold II, «the Tuscan Morpheus,» as Giusti calls him. During the flaccid rule of the latter, the entire administrative fabric of the state, in particular the civil service and the magistracy, had become honeycombed with inefficiency, servility and corruption. Aimed directly at the vicious system of political preferment in vogue in his state, Giusti's poem became a call for internal reform and in its larger aspect an appeal for Italian regeneration.

The poem itself which the author calls a dithyramb is a polymetric satire in praise of Gingillino, the perfect example of the cringing place seeker, whose career the poet describes from the cradle lullaby crooned to him by such deities as Cupidity, Duplicity, Sordidness, Intrigue, etc., to the final Credo of materialistic greed uttered by Gingillino in his maturity. It is difficult to decide whether to admire most the richness and variety of the metre so full of movement and animation, the subtle irony which the great poet and critic Carducci compares to Parini's immortal verse, the Byronic incisiveness and pungency of the satire, the picturesque colloquialness of the Tuscan idiom which the poet wields with unerring skill, or the power of political invective which makes him the greatest Italian satirical poet of the 19th century. With the lapse of time and the changes in political conditions, the satire has lost some of its sting. Then too the language of Giusti is so characteristic of his native province that it takes a Florentine to get the real flavor and tang of 'Gingillino.' It remains none the less, with its enormous popularity in its own day and its wholesome moral tone, one of the noblest poems of Giuseppe Giusti.

For the Italian text and criticism consult 'Versi editi e inediti di Giuseppe Giusti' (Florence 1852); Carducci, G., 'Poesie di Giuseppe Giusti' (1859); Puccianti, G., 'Poesie di Giuseppe Giusti' (1913). Also Horner, Susan, 'The Tuscan Poet, Giuseppe Giusti, and His Times' (London 1864); Howells, W. D., 'Modern Italian Poets' (New York 1887).

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GINGKO, the Japanese and also the scientific name of a genus of trees, forming a peculiar family, *Gingkoaceæ,* of the gymnosperms. *Gingko biloba,* the only species, is a tree which sometimes attains a height of nearly 100 feet. Its head is conical, and the branches are usually horizontal. The leaves are fan-shaped, thick and coriaceous, marked with longtitudinal nervures, their resemblance to the maidenhair fern giving it its English name of maidenhair tree. It is a native of China and Japan, although it is not known in a wild state, and was first introduced into Europe in 1754. Its fruit, which is of the size of a small plum, has a pulp with a disagreeable odor of butyric acid and enclosing a kernel which, when roasted, may be used as food, having a taste like that of maize. It is largely eaten throughout China and Japan. The Japanese consider the tree sacred and plant it near their temples. The gingko is considerably used as an ornamental tree in England and in the United States. It flourishes best in the shade, in a deep and somewhat moist soil.

GINIGARAN, hē-nē-gä'rän, Philippines, a pueblo of the province of Negros Occidental, at the mouth of the Ginigaran River on the east shore of Guimarás Strait, 29 miles south of Bacólod; it is also on the West Coast road. Pop. 13,620.

GINKGOLAS. See PALEOBOTANY.

GINSBURG, Christian David, eminent rabbinical scholar: b. Warsaw, 25 Dec. 1831; d. London, 7 March 1914. He was educated at the Rabbinic College in his native city, but came to England as a young man and spent the rest of his life there. He was one of the original members appointed by Convocation for the revision of the English version of the Old Testament, and was the author of 'An Historical and Critical Commentary on the Song of Songs' and on 'Ecclesiastes' (1857). For over 50 years Dr. Ginsburg enriched biblical literature with his erudite contributions. He rendered important service in 1883 by exposing the forgery committed by a well-known dealer in antiquities, named Shapira, of a manuscript purporting to be part of the «sources» of the book of Deuteronomy. Among his numerous works are 'The Kariates, their History and Literature' (1862); 'The Essenes' (1864); 'The Kabbalah, its Doctrines, Development and Literature' (1865); 'The Massoreth-ha-Massoreth of Elias Levita' (in Hebrew, with translation and commentary, 1867); 'Jacob ben

Chajin's Introduction to the Rabbinic Bible' (1867); 'The Moabite Stone' (1871); 'A Commentary on Leviticus' (1882); 'The Massorah' (4 large vols., 1880–86); a translation of the New Testament into Hebrew; 'Critical Text of the Hebrew Bible' (1894); 'Introduction' to the Massoretico — critical edition of the Hebrew Bible' (1897); series of facsimiles of 'Hebrew MSS. of the Old Testament' (1898); 'Relation of Codex Babylonicus to the Present Recension of the Massoretic Text of the Bible' (1899); 'The Hamburg Stadt-bibliothek Codex No. I' (1903); 'Pentateuchus Diligenter revisus juxta Massorah' (1908); 'Isaias' (1909), and numerous articles in Kitto's 'Encyclopædia of Biblical Literature,' Smith's 'Dictionary of Christian Biography and Antiquities.'

GINSENG, jin'sĕng, several species of herbs of the genus *Panax*, family *Araliaceæ*. The most noted species are *Panax ginseng*, a native of China, and *P. quinquefolium*, of eastern North America. These two species so closely resemble each other that the discovery of the latter near Montreal, Quebec, in 1716 was based upon a description of the former. The plants grow about 18 inches tall, bear 3 leaves, each composed of 5 leaflets, and end in a flower-stem bearing an umbel of small flowers from which develop conspicuous scarlet, generally two-seeded berries. The light yellow root, especially of the former species, is used by the Chinese for every conceivable domestic and medicinal use, and specimens resembling the human body often command their weight in gold because of supposed occult virtues. Neither species, however, is considered by Occidental physicians to have any pronounced medical qualities. The Asiatic species has long been cultivated in China and Korea.

Shortly after the discovery of the American species a shipment of the wild root was made to China and soon a trade was established. Since the plant has a natural range from the valley of the Saint Lawrence to the mountains of Georgia and westward to the eastern bank of the Mississippi, the wild supply of roots long met the demand. In 1858 the price was 52 cents a pound; in 1902, $5.55, the advance being largely due to the decrease of the native supply. In the latter year many lots of northern root (considered always better than southern) sold for $8 or even more. The advancing price led to many attempts to cultivate the plant, but until about 1885 none were reported successful. Then George Stanton of Apulia, N. Y., succeeded by growing the plant in beds prepared in the forest and later under lath sheds. These methods have led to the establishment of American ginseng growing. Cultivated ginseng has commanded about 20 per cent more than wild root from the same locality.

The plants thrive best in a well-drained, rather loose soil, well supplied with humus, potash and phosphoric acid, but not with nitrogenous material. Little has been done to improve the plant, but the time required to mature a crop of roots can probably be shortened considerably and the size of the root increased. In 1902 most growers calculated upon five years as necessary to mature a crop, but at the price of $2.50 a pound they figured upon making a profit under reasonably favorable conditions. The exorbitant prices paid for plants and seed during 1898–1903 were largely due to speculation, an exaggerated estimate of the demand in China, which is almost the sole market, and to the novelty of the industry, and hence the scarcity of plants and seed. Consult revised edition of Bulletin No. 16, Division of Botany, United States Department of Agriculture (Washington, D. C.); Kains, 'Ginseng' (New York 1902).

GINX'S (gĭnks'ĕz) **BABY,** the title of a famous book by John Edward Jenkins. It is a satire on the English poor laws and the administration of sectarian charitable associations, and was published anonymously in London in 1871. It speedily ran through many editions, was republished in the United States and excited warm controversy in the press and even in Parliament. It was followed by satires on other phases of social economy, but none of the other works of this author attained such a vogue or exerted such an undoubted influence upon the direction of social reforms.

GIOBERTINE (jō-bĕrt'ĭn) **TINCTURE,** a preparation for restoring writings which have become illegible through age, or faded pictures. The inventor of it was Giovanni Antonio Gioberti, a native of Piedmont (1761–1834). The invention has been invaluable in restoring the original writing of palimpsests. See PALIMPSEST.

GIOCONDA, La, a tragic opera by Amilcare Ponchielli (1834–86), with libretto by A. Boïto, first produced in Milan in 1876, in New York 20 Dec. 1883 and London 7 June 1886. Adapted from Hugo's 'Tyrant of Padua,' the plot is intensely dramatic, with a plentiful sprinkling of criminal deeds relieved by delightful music. The heroine, La Gioconda, is a beautiful ballad singer on the streets of Venice, with a blind mother, La Cieca, and a noble Genoese ship captain named Enzo Grimaldo as her lover. The villain, Barnaba, is a police spy of the Inquisition, and also in love with La Gioconda, whom he is determined to possess. The opening scene represents a Venetian regatta, in the course of which Barnaba declares his love to the girl and is repulsed by her. Barnaba incites the defeated regatta champion, Zuane, to kidnap La Gioconda's blind mother, whom he accuses of witchcraft. Enzo, however, comes to the rescue. Laura, a former love of Enzo, is now the wife of Alvise, one of the chiefs of the Inquisition Council. She throws her protection over La Cieca when Enzo recognizes her, and his old love revives. Barnaba informs him that Laura intends to visit his (Enzo's) ship that night, which sends the captain hurrying back on board. Barnaba now writes to Alvise telling him that his wife plans to elope with Enzo on the latter's vessel. That night Enzo is on deck awaiting Laura; Barnaba, disguised as a sailor, is near in a boat, having notified his police to be on hand. Laura appears, and Enzo prepares to set sail when La Gioconda enters; she quarrels with Laura and is about to stab her when her eyes fall on Laura's rosary. Repenting of her rashness, she aids her rival to escape and tells Enzo that Barnaba's war galleys are approaching to seize the ship. Enzo sets his ship on fire. Alvise, in his palace, orders his wife to take poison and leaves the room. Gioconda suddenly appears and gives Laura a narcotic to produce a trance, which the latter takes. Her husband, returning, thinks she has taken the poison, seeing her apparently lifeless body. Alvise later is giving a gorgeous masked ball in his palace, at which Enzo is present. Barnaba whispers to him that Laura is dead. Enzo denounces Alvise and is seized; the latter draws a curtain and exhibits the body of Laura to the horrified guests, acknowledging his crime. La Gioconda with help succeeds in carrying the unconscious Laura to a lonely island in the Adriatic and, having sent for Enzo, intends to restore the lovers to each other and to commit suicide herself. On the arrival of Enzo — who expects to see Laura's grave — he goes through a bitter scene with Gioconda. Laura returns to consciousness; Gioconda helps them to escape together and is then about to take the poison when Barnaba appears and fiercely asks why she broke her word to him. The girl pretends to yield; as Barnaba moves toward her she stabs herself to the heart exclaiming, «Gioconda is thine!» Bending over the corpse, Barnaba shrieks into her ear that he had strangled her blind mother the night before.

GIOJA, jō'yä, **Flavio**, Italian mariner: b. Pasitano, near Amalfi, in the latter part of the 13th century. He is said to be the inventor of the mariner's compass, of which he made use in 1302–03. The tendency of the loadstone to turn toward the north was known before his day, but the compass then in use consisted only of a magnetized reed floating upon cork in a vessel of water. Gioja invented the plan of suspending it on a pivot, thus leaving it free to move in any direction, whereby observations were rendered both more easily and more exact.

GIORGIONE, jŏr-jō'nē (easel name of GIORGIO BARBARELLI or BARBARELLA), Italian painter: b. Castelfranco, 1478; d. Venice, 1511. He was a pupil of Giovanni Bellino and painted history and portraits. He was one of the most celebrated of the Venetian school, was a fellow student of Titian, whom he might have rivaled had he not died of the plague in early life, while Titian lived for nearly a century. In his work he introduced the places and scenes of his nativity. To him Venetian painting owes much of its marvelous technique, and by his example in the use of pigments and glazings he set an example many followed; he has had more pictures by other hands attributed to him (nearly a hundred) than any other Italian master. Even connoisseurs have been deceived by the depth and richness of coloring, the luminosity of aerial perspective, which his imitators had learned from him too well. Yet there are not more than 12 authentic pictures by Giorgione. Among these may be mentioned 'The Enthroned Madonna with Saint Francis and Liberal,' an altarpiece for the church of Castelfranco; 'The Gypsy and Soldier,' and 'The Family of Giorgione' at Venice; 'Three Philosophers' and 'Evander showing Æneas the Site of Rome' in Vienna; and the 'Sleeping Venus' in the Dresden Gallery. Consult Berenson, 'Italian Painters of the Renaissance' (New York 1910); Cook, 'Giorgione' (London 1900); Morelli, 'Italian Painters of the Renaissance' (New York 1909); and Venturi, 'Giorgione e il Giorgionismo' (Milan 1913).

GIOTTO, jŏt'tō (called GIOTTO DI BONDONE), Italian painter and architect: b. Vespignano, near Florence, about 1266; d. Florence, 8 Jan. 1337. He was the son of a peasant and his first employment was in the tending of sheep and cattle. But having been on one occasion seen by Cimabue, as he was drawing figures of his sheep upon a piece of slate with a stone, that artist obtained leave from his father to take him with him, carried him to Florence and taught him painting. This may be a mere story, but at any rate his first teacher was Cimabue. His natural talent, and especially the gracefulness so peculiar to him, developed so rapidly that he soon surpassed all contemporary artists. He represented the human figure in his pieces with truth and nature and excelled in the dignity and pleasing arrangement of his figures and in his regard to correct proportions and natural disposition of the drapery. His earliest extant works are mural paintings in the church of Saint Francis at Assisi, executed before the end of the 13th century. He was now called to Rome, and after painting various works there he went to Padua in 1303 and adorned the chapel of the Annunciata dell' Arena with a series of famous frescoes, including 38 subjects, disposed in three rows, on the sides of the chapel and the front of the chancel wall, with a vast representation of the 'Last Judgment' filling the west end. Dante was his guest at Padua in 1306, and he is celebrated in the great poet's 'Divina Commedia.' He was also a friend of Petrarch. He worked at Milan, Verona, Ravenna, Rimini and Arezzo. In 1330–33 he was at Naples and in 1334 was appointed master of the cathedral works and other undertakings at Florence, where he designed the celebrated Campanile, a structure finished by his scholar and godson, Taddeo Gaddi. Besides the frescoes at Assisi and Padua, comparatively few works of Giotto are extant. Among his most celebrated pieces is the 'Navicella' (ship) at Rome (a picture of 'Peter Walking upon the Waves,' in mosaic). The National Gallery possesses a 'Coronation of the Virgin' painted in tempera, on wood. «The influence of Giotto was profoundly felt over the greater part of Italy. His example caused a revolution in art, the effects of which are traceable into the 15th century.» Many anecdotes of more or less authenticity are told regarding this painter. On one occasion, when asked for a sample of his art to show the Pope as a guarantee of his ability, Giotto is said to have drawn a perfect circle with a single stroke; whence «round as the O of Giotto» became proverbial. Consult Crowe and Cavalcaselle, 'History of Painting in Italy' (1864–66); Janitscheck, 'Die Kunstlehre Dantes und Giottos Kunst' (1892); Ruskin, 'Giotto, and His Works in Padua' (1854–60); and monographs by Perkins (1902); Thiorle, (1902); and Zimmermann (1899).

GIPPSLAND, Australia, the southeasterly of the four districts into which Victoria is divided, so named after an early governor. It forms the southeast portion of Victoria and has an area of 13,898 square miles. Its length from west to east is 250 miles and mean breadth about 80. It was originally called Caledonia Australis by Macmillan, its first explorer (1839).

GIPSY-MOTH, a large moth (*Porthetria* or *Ocneria, dispar*), of the family *Liparidæ*, is of common occurrence in central and southern Europe and the temperate parts of Asia. Professor Trouvelot imported them for research purposes in 1868 into Medford, Mass. and by accident some specimens escaped; but it was not till 20 years after that its ravages became a menace by defoliating shade-trees; and it has cost the State upward of $3,000,000, besides the outlays of individuals and municipalities. The sexes of the moth differ greatly, the male expanding only about one and a half to two inches, while the female measures across its expanded wings two and a half inches; the female is spotted brownish and the male is white, marked with black lines. The former lays her eggs in masses to the number of 500 wherever convenient, covering them with hairs and scales from her own body. The females have such heavy abdomens that the wings are inadequate for flight, hence the insect, owing to the measures which have been employed to prevent its artificial carriage, has not spread far beyond the place where originally introduced. The caterpillar measures when mature about 1.5 inches, is white, with black markings and furnished with long hairs. It is arboreal and capable of being most troublesome on shade, forest and fruit trees, but when abundant it feeds and develops on any form of vegetation. A single generation is produced annually. The best means of combating it are spraying with arsenical mixtures the collection of the cocoons and egg-masses and destroying them; the scraping of loose bark from trees, thus destroying the young and depriving them of hiding places; also the destruction of the eggs by means of oily substances and the trapping of the larvæ with strips of burlap placed about the infested trees. Consult 'The Gipsy Moth,' by Forbush and Fernald (Boston 1896); Howard, 'The Gipsy Moth in America' (Department of Agriculture, Washington 1898).

GIRAFFE, jĭ-răf', or **CAMELOPARD**, the tallest of mammals (*Giraffa camelopardalis*), the type of a family of ruminants (*Giraffidæ*), intermediate between deer and antelopes, and also containing the okapi (q.v.). It is a native of Africa south of the Sahara, but is now to be found only in the interior, remote from civilization and where there are brushy plains or open forest, and is fast decreasing. It occurs generally in small herds of from 5 to 40. It feeds on the leaves and small branches of trees, especially mimosas, which in districts where the animals abound are kept cropped to a convenient height for browsing. Its general aspect is remarkable from the height of the foreparts and great elongation of the neck, the head being sometimes 18 feet from the ground. The number of vertebræ in the neck, however (seven), is not greater than in other quadrupeds, and it has no extraordinary flexibility, although its form and movements are very graceful. The length, therefore, is due to the elongation of each cervical vertebra. The body is short, and the back slopes from the shoulder to the tail; yet the greater height of the foreparts is not entirely owing to the greater length of the fore-legs, but to the neural processes of the vertebræ, which form a basis for the support of the neck and head. The head is long, capable of a wide range of movements, and the upper lip is projecting and somewhat prehensile, while the tongue is remarkably capable of elongation, and can be thrust far out of the mouth, and employed to grasp and take up even very small objects; it is said that its tip can be so tapered as to enter the ring of a very small key. The usefulness of such an organ for drawing in leaves and branchlets to the mouth is obvious. The giraffe adroitly picks off the leaves of acacias and other thorny plants, without taking the thorns into its mouth. The dentition of the giraffe agrees with that of antelopes, sheep and oxen; the upper jaw of the male is destitute of the canine teeth which are present in the male of many deer.

Anatomically the most remarkable feature of the giraffe is the presence in both sexes of two protuberances between the ears, generally described as horns, but very different from the horns of other animals, and each consisting of a permanent bone united to the skull by an obvious suture, covered with skin and hair, and terminated by long hard bristles. These long outgrowths correspond to the bony core of the antelope's horn or to the pedicel of the antler in the deer. There is also a projection on the forehead, which, in the giraffes of South Africa, is so elongated as to indicate a separate species (*G. australis*) in the opinion of recent naturalists. If this view be accepted then the name *camelopardalis* applies properly only to the giraffes now to be found only in Somaliland. Moreover, Sir H. Johnston has reported that there exists in Uganda a very brilliantly colored form which has five horny protuberances, instead of three, upon the head; and when better known may prove to be in a new genus as well as of a novel species. The hair of the giraffe is short and smooth, with a short mane on the neck, and a tuft on the end of the tail. The color is reddish-brown in irregular areas sharply marked off by white borders, like the mortar between brick-work; but there is much variation in tint as well as pattern. A few extinct forms are found fossil in the Pliocene beds of China, India and Greece, of which *Samotherium* and *Hallidotherium* are prominent examples; they had a shorter neck and legs and more bovine appearance than their successors, and the males alone have horns.

The giraffe is an inoffensive animal, and generally seeks safety, if possible, in flight, although it is capable of making a stout resistance, and is said to beat off the lion by kicking with its hind-legs, discharging a storm of kicks with extrordinary rapidity. It is not easily overtaken even by a fleet horse, and has greatly the advantage of a horse on uneven and broken ground. Its pace is described as an amble, the legs of the same side moving at the same time. The giraffe was known to the ancients, and was exhibited in Roman spectacles. Representations of it appear among Egyptian antiquities. It has been supposed to be the zemer of the Jews, translated chamois in the English Bible (Deut. xiv, 5).

It is one of the costliest and most uncommon animals in menageries, although in former years they were kept and bred in Europe. The flesh is excellent meat, and the hide is thick and makes good leather. Consult Beddard, 'Mammalia' (1902), Lyddeker, 'Game Animals of

Africa' (1908) and the writings of naturalists and sportsmen in Africa, especially Johnston, Baker, Bryden, Gordon, Cumming, Harris, Holub and Selous.

GIRALDA, hē-räl'dä (Spanish *girar,* "to turn round"), a weathercock in the form of a figure or statue. It is pre-eminently applied to the weathercock, and from that to the Moorish tower or minaret (part of the cathedral) which it surmounts at Seville, Spain. The figure in this weathercock is that of Faith, which turns round to face every wind and storm. In the copy of the tower of Seville Cathedral which appears in Madison Square Garden, N. Y., the figure of Faith is replaced by that of Diana.

GIRALDUS CAMBRENSIS, or GERALD DE BARRI, Welsh churchman and historian: b. Pembrokeshire c. 1146; d. 1220. His 'Topographia Hibernica' and his 'Expugnatio Hibernica' written as the result of a journey to Ireland in 1184 as chaplain to Prince John, are valuable but somewhat biased descriptive and historical records of the Ireland of the period. His best work is the 'Itinerarium Cambrense' written after he went to Wales in 1188 with the primate Baldwin to preach the Third Crusade. He received his early education from his uncle the bishop of Saint David's, and continued his studies at Paris. After several progressive church positions, in 1198 he was elected bishop of Saint David's, but strong opposition set in, and despite three visits to Rome, in 1202 he was superseded in the new election ordered by the Pope. His numerous writings appeared in the Rolls edition (8 vols., London 1861–91); his itineraries in one volume are published in 'Bohn's Antiquarian Library.' Consult Gross, 'Sources and Literature of English History' (London 1900); Hoare, trans. 'Itinerary through Wales' (2 vols., London 1806); Owen, 'Gerald the Welshman' (London 1889).

GIRARD, Charles, American naturalist: b. Mülhausen, France, 1822; d. 1895. In 1839 he was a pupil of Agassiz, at Neufchâtel, Switzerland, and soon became one of his assistants, accompanying him to America, and remaining his assistant until 1850. He was attached to the Smithsonian Institution 1850–59, and has published 'Herpetology of the United States Exploring Expedition under Captain Wilkes' (1858); and many professional articles and monographs.

GIRARD, zhē-rär, **Marc Amable,** Canadian politician: b. Varennes, province of Quebec, 25 April 1822; d. Winnipeg, 10 Sept. 1892. In 1871 he was admitted to the bar of Manitoba, in whose politics he was long active as treasurer (1870–72), premier (1874), and later secretary, minister of agriculture and president of the council. In 1871 he was appointed a senator of the Dominion of Canada.

GIRARD, Paul, French scholar: b. Paris, 23 March 1852. He is professor of Greek language and literature in the University of Paris; also he is a lecturer and writer on antiquarian subjects and has been very actively engaged in organizing conferences of various kinds, but all of a scientific nature. He is a member of the Antiquarian Society of France since 1896 and also of the Ecole Française of Athens. Among his published works are 'L'Asklépieion d'Athènes d'après les récentes découvertes' (1881); 'De Locris Opuntiis' (1881); 'L'Education athenienne aux V^e et IV^e Siècles avant J.-C.' (1889); 'La Peinture antique' (1891). He was also a regular contributor to the *Revue des Deaux-Mondes* and the magazine *Le Moment,* the latter the official publication of the Society for the Advancement of Greek Studies.

GIRARD, Paul Frédéric, French legal writer: b. 26 Oct. 1852. He is professor of Roman law in the faculty of law, University of Paris, and was lecturer on law in the law school at Montpellier (1880–88), and the law school of Paris (1888–93). He has done very much research work of an original character in Roman law, and has to his credit a long list of works on the subject, in magazines, society journals, reviews and in books issued under his own name. Among the latter are 'La garantie d'éviction en droit romain' (1884); 'Textes de droit romain annotés' (1890–1903); 'Manuel de droit romain' (1896–1906); 'Histoire de l'organisation judiciaire des Romains' (1901); 'Actions noxales' (1887–88); 'Histoire de la Condictio' (1895); 'Histoire des XII tables' (1902); 'Edit Pretorien' (1904). He also translated into French Mommsen's 'Roman Public Law.'

GIRARD, Philippe Henri de, French inventor: b. Lourmarin, France, 1 Feb. 1775; d. Paris, 26 Aug. 1845. Successively painter, soapmaker and professor of chemistry, he was a man of versatile, scientific tastes, who concentrated his powers on mechanics. When Napoleon offered 1,000,000 francs as a prize for a machine that would spin flax, Girard invented the machine, but the fall of Napoleon deprived him of the reward. In 1815 he settled in Austria, built a flax-mill at Hirtenberg and afterward inaugurated steamboat service on the Danube. At the invitation of the Russian tsar he went to Poland in 1825, established a flax-mill which became the centre of the village of Girardou, and became chief engineer of the mines in Poland. He returned to France in 1844.

GIRARD, Stephen, American financier and philanthropist: b. Bordeaux, France, 24 May 1750; d. Philadelphia, 26 Dec. 1831. He followed the sea, becoming a master in 1773 and soon afterward engaging in the West Indian and American coasting trade. In 1769 he settled in Philadelphia as both shipmaster and merchant. After the Revolutionary War his business rapidly increased. He invested largely in the shares of the old Bank of the United States in 1810, and in 1812, upon the lapsing of its charter, purchased a controlling interest and the building. He named it the Bank of Stephen Girard and, retaining the old officers, made it one of the foremost financial institutions of the country. During the War of 1812 Girard was the principal financial support of the American government; in 1814 he subscribed for about 95 per cent of the war loan of $5,000,000. His fortune at the time of his death was undoubtedly the largest in America, amounting to about $7,500,000, almost all of which he left in public benefactions. For the erection and maintenance of a school for white male orphans he left about $5,260,000. (See Girard College). He was a man of unusual individuality, brusque and distant in manner, possessed of great foresight, practical and generous in his charities. During the rage of yellow fever in Philadelphia in 1793 he was ever present in relieving the afflicted, both by his free giving and by his personal care. Consult Ingram, H. A., 'Life and Character of Stephen Girard' (Philadelphia 1884); MacMaster, J. B., 'The Life and Times of Stephen Girard' (Philadelphia 1918); Rupp, G. P., 'Stephen Girard — Merchant and Mariner' (in 'Semi-Centennial of Girard College,' ib. 1898).

GIRARD, Kans., a city and county-seat of Crawford County, on the Atchison, Topeka and Santa Fé and Saint Louis and San Francisco railroads. Its situation is well adapted to agricultural pursuits, stock-raising, etc., and the industries include zinc smelting, stove manufacturing, flour-mills and brickyards. The city owns its own waterworks and electric-lighting plant, and has adopted the commission form of government. Pop. about 2,500.

GIRARD COLLEGE, Philadelphia, Pa., an institution for the vocational education and maintenance of "poor white male orphans," as the donor of the trust fund expressed it. The college was founded under the will of Stephen Girard (q.v.), and opened 1 Jan. 1848. By a provision in the will no ecclesiastic, missionary or minister of any sect whatever is permitted to hold office in this institution or to enter its premises at any time or for any reason. That provision should, however, not be interpreted as a reflection upon any sect or person; on the contrary, the founder's desire was, as he himself stated, simply that the minds of the boys reared by the institution should be kept free from the confusion of denominational controversies, so that "on their entrance into active life they may adopt such religious tenets as their natural reason may enable them to prefer." "The purest principles of morality" were to be instilled into the minds of the scholars. The original fund, $5,260,000, has been increased by good management to over $32,000,000, excluding the plant. The main building was completed in 1847. In addition to it there are at present about 20 other buildings, among them a chapel, school building, dormitories, infirmary, dining hall and mechanical school building. The normal capacity is given as 1,520 pupils; the grounds are extensive — 40 acres within the college wall; and the institution embraces a primary school (four years), grammar school (three years) and high school (four years). (See EDUCATION, TECHNICAL). Consult MacMaster, J. B., 'The Life and Times of Stephen Girard, Mariner and Merchant' (2 vols., Philadelphia 1918).

GIRARDIN, zhĕ-rär'dăṅ, MADAME **Delphine Gay de,** French poet and novelist: b. Aix-la-Chapelle, Rhine Province, Prussia, 26 Jan. 1804; d. Paris, 29 June 1855. Carefully educated by her mother, Sophie Gay, her poetry attracted notice at the age of 15, and she afterward attained some success in prose fiction and in writing for the stage. In 1831 she married the eminent journalist, M. Emile de Girardin. She contributed to the *Presse,* conducted by her husband, her 'Lettres parisiennes,' which, under the pseudonym of the "VICOMTE DE LAUNAY," attracted admiration by their wit and liveliness and are the best of her work. Her beauty no less than her wit made her salon a centre of attraction.

GIRARDIN, Emile de, French journalist and politician: b. Paris, 22 June 1802; d. there, 27 April 1881. He bore the name of Delamothe till 1827, when he assumed that of his father, Alexander, Count Girardin, who acknowledged him in 1847; and his first attempt in literature was a novel, 'Emile,' in which he pleaded the cause of illegitimate children. After the July revolution of 1830 he established the *Journal des Connaissances Utiles,* and in 1836 founded the *Presse,* an Orleanist journal with Conservative leanings. Its rivals accused it of being subsidized by the government, and one of the unfortunate results of the quarrels thus fastened on Girardin was his duel with Armand Carrel, editor of the *National,* in which the latter fell. He promoted Louis Napoleon's election to the presidency, and afterward became a Socialist. In 1856 he sold his share of the *Presse,* but became its editor again in 1862, eventually abandoning it for the direction of the *Liberté,* which he maintained till 1870. During the Commune he proposed a scheme for splitting up the republic into 15 federal states. In 1874, however, he founded the *France,* and both in its pages and in the *Petit Journal* supported the republic. He wrote (sometimes quite successfully) for the stage; his political ideas he gave to the world in a host of brochures; and he did not shun the serious handling of large public questions. We mention particularly 'La Politique universelle' (4th ed., 1854), and 'Le Supplice d'une Femme' (1865).

GIRARDON, zhĭ-rär'dôṅ, **François,** French sculptor: b. Troyes, 17 March 1628; d. 1715. He began life as a wood carver, learned to paint, but all the while intended to become a sculptor. His first effort was a statue of the Virgin for Troyes, his birthplace. With Bandesson, his master in wood-carving he was engaged in renovating the château of Seguier at Saint Liébaut. Seguier took a deep interest in the young craftsman and sent him to Paris and later to Rome. At Rome he came under the influence of Bernini. In 1657 he entered the Academy of Painting and Sculpture and was married to the painter, Catherine Duchemin, the same year. He was sent to Toulon in 1667 to supervise the decoration of naval vessels, a second visit to Rome followed in 1668 and the following year he returned to Paris, where he lodged in the Louvre and was professor at the academy. He enjoyed a large measure of court favor and was made chancellor of the academy in 1695. The Richelieu monument at the Sorbonne is his greatest work. Happily it was saved at the Revolution. In the Louvre are several busts and other small works. The palace and park of Versailles contains most of his decorative work. Consult Corrard de Breban, 'Notice sur la vie et les œuvres de Girardon' (Paris 1850).

GIRARDVILLE, Pa., borough in Schuylkill County, 60 miles northwest of Reading, on the Lehigh Valley and the Philadelphia and Reading railroads. It is the seat of a State hospital. Anthracite coal mining is the chief industry. The borough was settled in 1841 and is governed by a chief burgess and council of nine members. Pop. 4,396.

GIRART DE ROSSILHO, zhē-rär' dẹ rôs-sil'o, an epic in northern Provençal and part of the great Carlovingian literary cycle. (See PROVENCAL LITERATURE). Consult Saintsbury, 'French Literature' (6th ed., Oxford 1902).

GIRASOL, precious stones which reflect bright or red or yellow light apparently from the centre of the mineral. The fire opal is the best-known kind. Among the ancients such stones were highly prized and were bought for large sums. Modern inventive genius has succeeded in making them artificially and they are no longer high-priced nor highly prized.

GIRASOLE, or **JERUSALEM ARTICHOKE,** a species of sunflower, of the genus *Helianthus,* native of the western hemisphere. In northeastern United States and adjacent Canada this and other closely allied species develop edible tubers. The tubers arise from underground stems or earth-branches but differ from the potato in that the branch itself may swell up and become a tuber. The species producing tubers are *H. tuberosus, H. subtuberosus,* the so-called Indiana potato of Michigan and Minnesota. The species, *H. doronicoides,* native from Ohio to Arkansas, is used as food in Europe. These tuber-bearing species were well known to the aborigines of America befor the advent of the whites. We find them mentioned by Champlain in 1603, and specimens of *H. tuberosus* were brought to France by Lescarbot. The Jerusalem artichoke (*H. tuberosus*) is the tuber-bearing species par excellence, and is the only contribution of North America, exclusive of Mexico, to the vegetable garden of the world. The name artichoke appears to have been given it solely on account of its flavor, which is more or less similar to that of the Old World artichoke (*Cynara scolymus*), while «Jerusalem» is an English corruption of the Italian *Girasole,* sunflower. The term «Jerusalem artichoke» is therefore very misleading. At the present time it is in higher esteem in the Old World than in the land of its origin. The tubers are planted three feet apart, in rows two feet apart, each plant occupying six square feet. In good soils no fertilizer is needed and the yield averages about nine tons to the acre. As compared with potatoes the yield per acre is greater in the regions best adapted to the artichoke — the intermediate region between the sweet potato of the South and the potato of the Northern and upland regions. It is an excellent food for hogs and may also be used as a boiled vegetable, as salad or in soup for man. Consult 'Farmers' Bulletin 331' (Washington, D. C.) and article by T. D. A. Cockerell (in *The Scientific Monthly,* March 1918).

GIRDER, a beam, of wood or metal, spanning the distance from wall to wall or pier to pier, and used to support a superstructure or superincumbent weight, as a floor, the pathway of a bridge, etc. Girders are often compound, the timbers being scarfed together and stayed by truss-work or fished at the joint. The ends of the girder rest on the wall or pier, the length of the bearing depending upon the length of the span (increasing proportionally), the material of the girder and the weight to be sustained. The ends rest on templates. Girders are of various sorts, according to the purpose for which they are required. A sandwich girder is one which is composed of two wooden beams with an iron flitch plate between, all bolted together. See BRIDGE CONSTRUCTION, MODERN METHODS OF; BUILDING.

GIRDER BRIDGES. See BRIDGE CONSTRUCTION, MODERN METHODS OF.

GIRDLE OF VENUS, a jellyfish of the Mediterranean, shaped in ribbon fashion and attaining a length of about five feet and a width of two inches. It shows splendid colors by day and a phosphorescence by night. It moves by means of swimming plates on its edges. It is of such delicate structure that to obtain a perfect specimen is a matter of the greatest difficulty.

GIRDLER, a small American longicorn beetle (*Oncideres cingulatus*), which in August lays an egg in a hole bored into a twig of a hickory, pear or other tree, and then gnaws a deep groove below the egg, thus girdling the twig. This kills the extremity and provides a supply of dead wood as food for the grub, which is soon hatched. The grub eats all the woody tissue, and within the concealing shell of bark remaining, pupates and passes the winter, becoming a full beetle and emerging the following spring. When this insect is numerous it may do serious damage to forests and orchards.

GIRDWOOD, Gilbert Prout, Canadian educator: b. London, England, 1832. He received his education at University College and Saint George's School of Medicine, London, and in 1864 became assistant surgeon to the British Grenadier Guards. He settled in Montreal and in 1865 became surgeon to the Third Regiment, Victoria Rifles, and served during the campaign against the Fenian raiders of 1866. From 1872 to 1894 he held the chair of practical chemistry at McGill University, Montreal, and was made professor emeritus in 1902. He also served as director of the electrical department and Roentgen rays at the Royal Victoria Hospital. He is a Fellow of the Royal Society of Canada and is a member of many scientific societies, both Canadian and foreign. He is the author of many articles on medical and surgical topics contributed to the *Lancet,* the Montreal *Medical Journal* and the *Transactions of the Royal Society of Canada.*

GIRGEH, gēr'gä, Egypt, capital of the province of the same name and once the capital of Upper Egypt, on the Nile, 90 miles southeast of Assiut. There are many ancient tombs and cemeteries in the neighborhood. The town contains several mosques, a Coptic convent, a government cotton factory and has a great weekly market. Pop. 20,000, including about 5,000 Copts.

GIRGENTI, jēr-jăn'tē, Sicily, capital of the province of the same name, on the Drago, 85 miles southeast of Palermo and about 1,000 feet above sea-level. It is situated about three miles inland, is an episcopal see and a military headquarters for the province. It contains a magnificent 14th century cathedral, a museum with many ancient and priceless relics, numerous catacombs, a public library, technic school, gymnasium, normal school and municipal theatre. It has large salt mines and exports sulphur, wine, oil, grain, cheese, honey and fish. Consult Baedeker, 'Southern Italy' (Leipzig 1912); Picone, 'Memoire stariche agrigentine' (Girgenti 1865).

GIRL OF THE GOLDEN WEST. The name (1) of a play by David Belasco, produced in 1905, and (2) of an opera composed by Giacomo Puccini, under the Italian title of 'La Fanciulla del West,' first produced at the Metropolitan Opera House, New York, 10 Dec. 1910. On that occasion the principal character, Minnie (the girl) was played by Mme. Emmy Destinn; that of Ramerrez the highwayman — alias «Dick Johnson» the hero — by Signor Caruso, and the rôle of the sheriff, Jack Rance, by Pasquale Amato. Signor Toscanini conducted the orchestra, and the composer and author were present. The action, which had been modeled by the Italian librettists, Signori Zangarini and Civinni, closely on that of the Belasco play, depicts certain phases of life in a California mining camp of '49. The «girl of the golden West,» in a series of spirited incidents verging to the point of tragedy, exerts a refining influence on the environment of rough manhood, and redeems and marries the chief offender. Well-balanced orchestration and picturesque, «nerve-gripping» solos and choruses, make a strikingly descriptive opera.

GIRLS' CLUBS, societies with a membership of girls banded together for recreation, study, mutual helpfulness, etc. Formerly there was apparently less spontaneity among girls than among boys in regard to the formation of clubs; now large numbers of girls are found in clubs organized and to a greater or less degree supervised by older persons. In women's clubs, so called, large numbers of girls are found either as regular members or in a junior branch or department. Some large societies, such as the Young Women's Christian Association, do not apply the name club to any of their branches, and could not accurately do so, and yet the opportunities they afford to girls for entertainment, self-improvement and social intercourse and the use of rooms for gatherings, reading and writing, etc., afford to members what is largely equivalent to club membership, a fact appreciated by the girls themselves, who sometimes give as a reason for joining such societies the wish to be connected with «a club.» Many girls are found in the large organization known as King's Daughters and Sons, especially in the junior circles. In such bands, religious or benevolent features predominate, but the social element is cultivated in a greater or less degree. The Girls' Friendly Society is also largely of a religious nature but in additon to church and missionary work it provides opportunities for recreation and for the mental and industrial training of its members. Instruction in hygiene is an important feature, and music receives much attention. The aim of the society is to encourage purity of life, dutifulness to parents, faithfulness to employers and thrift; and to cultivate a spirit of fellowship and kindliness. It ensures the privileges of the society to its members wherever they may be, by giving them an introduction from one branch to another. The parent society was started in England in 1875 (at a time when much interest was shown in «rescue work»), with the central idea of helping young women along preventive rather than reformatory lines. The form of organization follows as far as possible that of the Church of England, being diocesan and parochial. Any girl of good character 12 years of age or over may become a member, and younger girls may become probationers or candidates. Associate members must be communicants. This society now extends wherever the English language is spoken and is the largest society of girls and women in existence, with a continually increasing membership. The Girls' Friendly Society in America is under the auspices of the Protestant Episcopal Church. Branches were started in Lowell, Mass., and in Baltimore, Md., soon after the organization of the English society, and a central council was formed in 1886. In 1916 the society reported 900 branches, in 67 dioceses; and a total membership (including associates, probationers, candidates, etc.) of 52,000. There are six holiday houses, belonging respectively to the diocesan branches of Massachusetts, New York, Pennsylvania, Rhode Island and New Jersey. The organs of the society are two monthly periodicals, *The Girls' Friendly Magazine* and *The Associates' Record*. The central office is in the Church Missions House, New York. Some individual churches maintain girls' clubs as a part of their parish work. The club connected with Saint Bartholomew's Church, New York, has a clubroom, baths, classes of various kinds and a mutual benefit fund. In the social, university and college settlements in large cities throughout the United States, clubs for girls generally constitute an important feature of the work.

The use of the word «girl» in connection with working-girls' clubs is somewhat vague, as the term is very elastic in its application. In most working-women's clubs girls are admitted who have passed the age of 14, but in some cases there are also junior clubs for the younger girls. These «sub-clubs» are to some extent under the supervision of the older members, but usually have their own officers and constitution. The State and city associations of working-girls' clubs secure for the individual clubs belonging to them enlarged advantages and more effective working. The results of united effort are illustrated by the success of the movement for the early closing of stores in Boston in 1896–97, a step due in great part to clubs having a membership largely drawn from girls in stores and factories. One of the objects of the Massachusetts association is to assist clubs in obtaining the services of good teachers, physicians and lecturers. Among the subjects very frequently taught in the classes connected with working-girls' clubs are plain sewing and embroidery, millinery, cooking, gymnastics and singing. Lessons in English literature, elocution, French, German, stenography, drawing, modeling and painting are also offered to many club members. In some of the clubs the teachers are paid and in others they contribute their services. Besides the more formal lessons, talks are often given to club girls on hygiene, nursing, morals, manners, etc.; and concerts, lectures and readings, with «evenings of travel» fill many of the evenings devoted to entertainment. Outings of various kinds form a summer feature in many clubs, and vacations are often made possible at cheaper rates than could otherwise be obtained by the members. Large clubs or associations conduct vacation houses at the seashore or in the country. The pleasures and privileges connected with club life form the brightest and most hopeful element in the life of many a self-supporting girl. See BOYS' CLUBS; CLUB; KING'S DAUGHTERS AND SONS, INTERNATIONAL ORDER OF; LEND A HAND CLUBS; WOMEN'S CLUBS; WORKINGWOMEN'S CLUBS.

GIRLS' FRIENDLY SOCIETY. See GIRLS' CLUBS.

GIRON, Colombia, town of the department of Santander, on the Lebrija River. Gold mining and tobacco culture are the principal industries. It was founded in 1631. Pop. 6,202.

GIROUARD, Désiré, dā-zē-rā zhē-roo-är, Canadian jurist: b. Saint Timothée, province of Quebec, 7 July 1836; d. 1911. He practised as a member of the Montreal bar 1860–95, and was a member of the Dominion Parliament for Jacques Cartier 1878–95. He carried the Deceased Wife's Sister Bill in 1882 and since 1895 has been a justice of the Supreme Court of Canada. He has published 'Essai sur Lettres de Change' (1860); 'The Bill of Exchange Act' (1890); 'Lake Saint Louis, Old and New and La Salle' (1893).

GIROUARD, zhē-roo-är', SIR **Edouard Percy Cranwill,** Canadian soldier and railway official: b. Montreal, 1867. He was educated at the Royal Military College of Kingston, Ontario, and served for a time on the engineering staff of the Canadian Pacific Railway. In 1888 he was made second lieutenant of the Royal Engineers, and lieutenant three years later. From 1890 to 1895 he was railway traffic manager at Woolwich. In 1896–97 he served in the Dongola expedition under Kitchener, was director of the Sudan railways in 1896–98 and in the following year president of the Egyptian railway board. During the war in South Africa he was director of railways there; in 1902–04 he was railway commissioner of the Transvaal and Orange River Colony; was made lieutenant colonel in 1904 and assistant quartermaster-general of the Western Command in 1906. In 1907 he was appointed High Commissioner of northern Nigeria and in 1909–12 was governor of the protectorate of East Africa. He was knighted in 1900. He wrote 'History of the Railways during the War in South Africa' (1905).

GIRONDE, zhē-rônd', France, a department of southwest France, bounded north by the estuary which gives it its name and the department of the Charente; east by Dordogne and Lot-et-Garonne; south by Landes; and west by the Bay of Biscay; area, 4,140 square miles. The whole department, with exception of the west, which sends its waters either directly to the coast or the long series of lagoons by which it is lined, belongs to the basin of the Gironde, which is formed in its interior by the junction of the Dordogne and Garonne. The only other streams deserving of notice are the Leyre, which discharges itself into the most southern lagoon; the Ciron, a left affluent of the Dordogne; and the Isle, with its tributary Dronne. The quantity of waste land is very great, amounting to more than one-third; while the arable land is rather less than one-fourth of the whole surface. Of the remainder about one-seventh is occupied by vineyards, and one-ninth under wood. The great staple of production is wine. The most celebrated wines are Médoc, Graves, Côtes, Palus and Entre-deux-Mers. (See WINES). The trade, which has its centre at Bordeaux, is very important. The principal exports are wine, brandy, corn, flour, fruit, resin, liqueurs, etc. The oyster fisheries are important. For administrative purposes Gironde is divided into six arrondissements — Bordeaux, Bazas, Blaye, Lesparre, Libourne and La Réole. The capital is Bordeaux (q.v.). Pop. 829,095.

GIRONDIST, jĭ-rŏn'dĭst, or **GIRONDIN,** the name of a great political party in France; one of the most powerful factors in the earlier part of the first French Revolution. When the Legislative Assembly met in 1791, it contained representatives of the upper, the middle and the lower classes. The Girondists were the party of the middle classes, and were republican in sentiment, but suffered from the lack of a definite policy. They obtained their designation from the fact that their most celebrated leaders, Vergniaud, Guadet and Gensonné, were members for the department of the Gironde, originally lawyers in the law court of Bordeaux. Sometimes they were called Brissotins from Brissot, their most eloquent leader. They were the most powerful party in the Assembly, and for a time shaped the policy of their country. When conservative Europe threatened France with invasion, the Girondists in April 1792 declared war, the Jacobins deprecating hostilities, as fearing the result. To overcome their monarchic rivals, the Girondists coquetted with the last-named party, and found that they had gained, not a servant, but a cruel and exacting master. The quarrel between the two arose after the massacres perpetrated in August and September 1792, and the extreme revolutionists ultimately prevailing, an armed mob on 31 May 1793 assailed the convention, and demanded the imprisonment of 29 Girondist deputies. These were arrested on 2 June, and 21 of them were guillotined on 31 October. Others were subsequently put to death; a few who escaped reappeared in the convention after the fall of Robespierre.

GIRTON (gĕr'tŏn) **COLLEGE,** England, a noted college for women, instituted at Hitchin, Hertfordshire, in 1869, but removed to Girton, near Cambridge, in 1873. The students, about 160 in number, are admitted after an entrance examination; the ordinary course extends over three years, half of each year being spent in college. Degree certificates are granted for the B.A. of Cambridge University. The college is governed by an executive committee, a mistress and vice-mistress.

GIRTY, Simon, American frontiersman and leader of the Indians: b. present Dauphin County, Pa., 1741; d. Canada 1818. He became a second lieutenant of Virginia militia, later an Indian interpreter, deserted to the English in 1776, was appointed an interpreter to the English Indian department, and was declared a traitor by the Pennsylvania legislature. His name was popularly associated with many Indian atrocities on the frontier, although it is likely that he was not at any time commander of a large force and that his prestige among the savages was much less than was supposed. He did, however, lead the Indians who attacked Dunlap's Station (1791) and Fort Jefferson (1791).

GIRVAN, Scotland, seaport and market town of Ayrshire, on the west coast, 20 miles southwest of Ayr. Herring fishing and weaving are its principal industries, but there is a large trade in coal and limestone which are produced nearby. The town is a popular health resort. Pop. 5,331.

GISBORNE, Frederick Newton, Canadian electrician and inventor: b. Broughton, Lancashire, England, 8 March 1824; d. 29 Aug. 1892. He went to Canada in 1845 and soon after engaged in telegraph work. He laid before the Nova Scotia authorities in 1850 a plan for telegraphic communication between Newfoundland and Ireland, and the first cable in America, which connected Prince Edward Island and New Brunswick, was laid by him 1852. In 1879 he was appointed superintendent of the Dominion government telegraph service. He achieved some note as an inventor.

GISLASON, gis'lä-sōn, **Konrad,** Icelandic philologist: b. Löngumýri, 1808; d. 1891. He was educated at the University of Copenhagen and from 1853 to 1886 held the chair of ancient Norse languages there. His editions of the 'Gislasaga' (1849) and 'Njála' (1875–89) attracted attention to him as an eminent philologist, which was borne out further by his studies and researches in Icelandic and his Danish-Icelandic dictionary. Consult 'Arkio for nordisk Filologi' (Vols. VII–VIII).

GISMONDITE, or **GISMONDINE** (named after C. G. Gismondi, an Italian mineralogist), a monoclinic transparent or translucent mineral of vitreous lustre, its hardness 4.5; specific gravity 2.27; sometimes colorless, sometimes white, bluish-white, grayish or reddish. It is optically biaxial. Composition: Silica, 35.88; alumina, 27.23; lime, 13.12; potassa, 2.85 and water, 21.10. Occurs in leucitic lava near Rome and in Sicily.

GISSING, George, English novelist: b. Wakefield, 22 Nov. 1857; d. Saint Jean de Luz, France, 28 Dec. 1903. In his stories he made a remarkable study of the London masses, from the ranks of skilled labor to the most noisome human refuse of the slums. He published 'The Unclassed' (1884); 'Demos' (1886); 'Isabel Clarendon' (1886); 'Thyrza' (1887); 'A Life's Morning' (1888); 'The Nether World' (1889); 'The Emancipated' (1890); 'New Grub Street' (1891); 'Born in Exile' (1892); 'Denzil Quarrier' (1892); 'The Odd Women' (1893); 'In the Year of Jubilee' (1894); 'Eve's Ransom' (1895); 'The Whirlpool' (1897); 'Human Odds and Ends' (1897); 'The Town Traveler' (1898); 'Charles Dickens, a Critical Essay' (1898); 'The Crown of Life' (1899); 'By the Ionian Sea' (1901); 'Veranilda' (1904); 'Will Warburton' (1905).

GIST, or **GUEST, Christopher,** Colonial scout, woodsman and surveyor; prominent in historical records 1749–53; was the son of Richard Gist who became presiding magistrate of Baltimore in 1736. His grandfather, after whom he was named, was an emigrant from England, who settled in Maryland on the south side of the Patapsco River in 1682, but in 1691 removed to Baltimore County. From 1749–52 he explored the Ohio Valley as far as the mouth of the Scioto River in the interests of the Ohio Company (q.v.), and the country north of the mouth of the Kanawha. While among the Miamis, Shawnees and Delawares, in 1750–51, his party founded Picktown or Pickawillany on the Big Miami, 150 miles from its mouth, which led to complications with the French. It was during this expedition that an old Delaware chief shrewdly asked him: "The French claim all the land on one side of the Ohio, the English all on the other side, tell me where does the Indians' land lie?" On 14 Nov. 1753 Washington on his important expedition to the Ohio to ascertain the French designs met Gist at Will's Creek (Cumberland River) and, previously acquainted, prevailed upon him to accompany the expedition as guide. He is said to have saved Washington from drowning while crossing the Allegheny River. His journal formed the foundation of the historical accounts of the expedition. He married Sarah Howard, whose father took an active part in quelling Monmouth's rebellion in England. Their son William, who became an officer in the British army, married Sarah Fincher, and was the grandfather of William Henry Gist (q.v.).

GIST, George. See SEQUOYAH.

GIST, Mordecai, Revolutionary soldier: b. Baltimore, Md., 1743; d. Charleston, S. C., 2 Aug. 1792. He came of the same family as Christopher Gist (q.v.), and in early life became a merchant in Baltimore. At the outbreak of the Revolution, he became captain of the first regiment raised in Maryland, and rapidly advanced to the rank of brigadier-general. He took prominent parts in the battles of Long Island, August 1776; in the battle of Germantown, September 1776; at the disastrous battle of Camden in 1780, with his brave Marylanders bearing the brunt of the conflict; and at the battle of Combahee, 26 Aug. 1782, saved the fortunes of the day, changing a disastrous defeat into a brilliant victory. He aided materially in the operations that led to the capitulation of Charleston and was present at the surrender of Cornwallis. The remaining years of his life were spent on his plantation at Charleston, S. C.

GIST, William Henry, 40th governor of South Carolina (1858–60): b. Charleston, S. C., 20 Aug. 1809; d. Rose Hill, S. C., September 1874. He was the son of Francis Fincher Gist and great-grandson of Christopher Gist (q.v.). In 1819 his parents removed to Union County and he was educated at the South Carolina College. He became the leading lawyer in the State; an active politician; was elected to the senate 1852–56; and governor of South Carolina in 1858. A staunch believer in State sovereignty, when the legislature met 5 Nov. 1860 he sent a message advocating both secession and resistance in the event of Lincoln's election and on 20 Dec. 1860 signed the ordinance of secession.

GITANOS. See GYPSIES.

GIUFFRIDA-RUGGERI, gwē-frē'dä rō-jē'ē, **Vincenzo,** Italian anthropologist: b. Catania 1872. He settled in Rome as a practising physician in 1896, made anthropological studies and taught this subject successively at Rome, Pavia, 1906–07, and since the latter year at Naples. He has published 'Sulla dignita morfologica dei segni degenerativi' (1907); 'Homo sapiens: Einleitung zu einem Kurse der Anthropologie' (1913); L'Uomo attuale, una specie collettiva' (1913).

GIULIO ROMANO, joo'lē-ō rō-mä'nō (properly GIULIO PIPPI DE GIANNUZZI), Italian artist, architect and engineer: b. Rome, about 1492; d. Mantua, 1 Nov. 1546. He assisted Raphael in several of the latter's works, including the 'Benefactors of the Church' in the Incendio del Borgo, and at Raphael's death inherited a great part of his wealth and completed the 'Battle of Constantine' and the 'Apparition of the Cross' in the Hall of Constantine in the Vatican. He built the Villa Madama, for which he painted a fresco of Polyphemus. In 1524 he accepted the invitation of the Duke of Mantua to undertake for him a series of architectural and pictorial works, restored the Palazzo del Tè, the cathedral, the streets and a ducal palace at Marmirolo, near Mantua. Among other Mantuan works of his are the 'History of Troy,' in the castle, and 'Psyche,' 'Icarus,' and the 'Titans,' in the Tè palace, and his abilities as an engineer were attested by his draining the marshes surrounding the city and protecting it from the overflow of the rivers Po and Mincio. In Bologna he designed the façade of the church of Saint Petronio. Other works are the 'Martyrdom of Saint Stephen,' at Genoa; 'A Holy Family,' at Dresden; 'Mary and Jesus,' and the 'Madonna della Gatta.'

GIURGEVO, joor-jä'vō, or **GIURGIN,** Rumania, town in Wallachia, on the Danube, opposite Rustchuk, 35 miles southwest of Bucharest. It is the port of the capital, has a custom house and exports grain, petroleum and salt. It is one of the chief commercial centres of the country, almost all the trade with Bulgaria passing through it. It was founded by the Genoese in the 14th century and under the Turks was a fortified military station. It suffered greatly in the wars between the Turks and Russians. Pop. 15,000.

GIURGIN. See GIURGEVO.

GIUSTI, jōōs'te, **Giuseppe,** Tuscan satirical poet: b. Monsummano, near Pescia, 13 May 1809; d. Florence, 31 March 1850. Son of well-to-do and intellectual parents, his early studies were made in Florence and Lucca. In 1826 he was sent greatly against his will to study law at the University of Pisa, but so little did he care for this career that it was only in 1834 that he got his degree and was admitted to the practice of his profession. Better known to the grand ducal police than to his teachers, already noted in his student days for his liberal associations and for his satirical verses against the Tuscan authorities, it was not long before Giusti abandoned law fo letters. In 1833 he satirized Francis IV, the ferocious Duke of Modena, in 'La Guigliottina a vapore' (The Steam Guillotine) with such success that the young author established himself quickly as the Béranger of Italy. His political and social satires, under the name of 'Scherzi' (Pleasantries) and 'Versi,' circulating at first surreptitiously in manuscript form, attacked the abuses of the day, the petty tyrants and the foreign oppressors of the peninsula. On the death of Francis I of Austria, Giusti wrote in 1835 his famous 'Dies Iræ,' a bitter invective against the implacable persecutor of Italian liberals. In the following year appeared 'Lo Stivale' ('The Boot'), a pathetic, quaint and pointed allegory, a plea for a united Italy. The poet rose to higher lyric pinnacles in the satirical ode, 'L'Incoronazione' (1838), when he bitterly assailed the coronation of Ferdinand I of Austria at Milan. 'La Vestizione' ('The Inauguration,' 1839), 'Il Ballo' and 'La Scritta' (1841) lay bare the abjectness of the old nobility and the upstart crassness of the new aristocracy. 'Il Brindisi di Girella' (1840), a brilliant satire on political chameleons, addressed to Talleyrand; 'La Terra dei Morti,' a reply to Lamartine's strictures on Italy; 'Il Re Travicello' ('King Log'); and other poems appeared in rapid succession. On account of his health, which had always been delicate, the poet interrupted his work in 1844 to travel to Rome and to Naples, then to Leghorn and finally to Pescia, where in 1845 he wrote 'Gingillino,' probably the loftiest in moral tone of his social satires. In 1846 he composed the splendid patriotic poem, 'Sant' Ambrogio,' and his powerful 'Delenda Cartago,' stirring in its fervid invective against the foreign oppressors. The latter years of Giusti's life were spent in the activities of the revolt of 1848. In 1847 already he was a major in the Guardia Civica of Pescia; in 1848 and again in 1849 he was elected a deputy to the Tuscan legislature, although his health soon became too delicate to permit his continuance in politics. As a political satirist, Giusti was a bitter opponent of foreign rule and interference in Italy. So greatly was his verse feared by the authorities, that no edition dared be printed before 1844. Giusti wrote in his racy Tuscan idiom, employing the popular dialect of his province with singular felicity, with a mastery of invective and a skill for concise characterization inimitably his own. His field at times is narrow, the abuses in local conditions and the evils of his day. He gave, however, to political satire a freshness of form, a vivacity of metre and a variety in rhythms that stamped him at once in Italy as the creator of a new type of poetry. Lacking the universality, the breadth of Béranger, to whom he has often been compared, he surpasses his French counterpart in form, in technical equipment and above all in poetic inspiration. Although his reputation has suffered somewhat through changes wrought by time and varying taste, Giusti's name "will survive as that of an original poet who sought and attained noble aims in civic education." See GINGILLINO and consult Carducci, G., 'Poesie di Giuseppe Giusti' (Florence 1859); Puccianti, G., 'Poesie di Giuseppe Giusti' (Florence 1913); Martini, Ferd., 'L'Epistolario di Giuseppe Giusti' (Florence 1904); Horner, Susan, 'The Tuscan Poet, Giuseppe Giusti, and his Times' (London 1864); Howell, W. D., 'Modern Italian Poets' (New York 1887).

ALFRED G. PANARONI.

GIVET, gē-vā', France, town in the department of Ardennes, on the Meuse, near the Belgian frontier and 25 miles south of Namur. It was formerly a fortified town but in 1892 the fortifications were made into boulevards and promenades. In August 1914 the town witnessed the stubborn defense of the British expeditionary forces against the advancing Germans, to whom it fell during the latter part of the month. Brewing, tanning, pencil-making and marble-working are the principal industries. Pop. 7,759.

GIVORS, gē-vôr', France, town in the department of the Rhone, on the Gier and Rhone, 15 miles south of Lyons. It has machine works, bottle and glass factories, and coal mines. Pop. 12,500.

GIZEH, gē'zĕ, **GHIZEH** or **GEEZEH,** Egypt, a town on the left bank of the Nile, almost directly opposite Cairo. Near it is the vice-regal palace. It was formerly an important place, beautified by palaces, but now forms a scene of ruins, amidst which the town is built. Five miles to the west are the great pyramids which have been named from this town, and here also is the famous Sphinx. Pop. about 11,500. Consult on the work here executed by the British School of Archæology, Flinders Petrie, 'Gizeh and Rifeh' (London 1907).

GIZZARD, a stomach or a part of it or of the alimentary canal where it is unusually muscular and tough, so that it is able to crush or grind solid food. It is not possessed by animals whose food is soft or else is chewed before swallowing; and is best developed among seed-eating birds, which frequently swallow pebbles to assist the gizzard in its grinding work. Birds not accustomed to hard food, if compelled and able to adopt such a diet, will develop a serviceable gizzard. Various fishes, reptiles, crustaceans, insects, worms and other invertebrates have gizzards. See *Digestive System* under ANATOMY, COMPARATIVE; STOMACH.

GJELLERUP, Karl, Danish author: b. Roholte, 2 June 1857. His home has been at Dresden during the greater part of his literary career. His interest in all things German, particularly in German art and music, has always been very great, and found its written evidence in 'Richard Wagner i hans Hovedwærk Nibelungens Ring' ('Richard Wagner in his Chief Work, the Ring of the Nibelung, 1890'). Among his novels are 'En Idealist' (1878); 'Det unge Danmark' (1879); 'Antigonos' (1880); 'Germanernes Lærling' (1882); 'Minna' (1889); 'Pastor Mors' (1894). Except for the translation of a novel dealing with the mystic life of India, 'The Pilgrim Kamenita,' none of his work has been printed in English. The Nobel Prize for Literature, for 1918, was divided equally between Gjellerup and another Danish writer, Henrik Pontoppidan (q.v.).

GLACÉ BAY, Canada, situated in Cape Breton County, Nova Scotia, about 15 miles east of Sydney, on the Sydney and Louisbourg Railway. It is the centre of a considerable fishing industry, and has also machine works, but the great industry is coal mining, being the seat of the Dominion Coal Company, which has a payroll of 5,000 men, and disburses annually in wages $5,000,000. Pop. 16,562.

GLACIAL ACETIC ACID. See ACETIC ACID.

GLACIAL DEPOSITS. See GLACIERS; GLACIAL PERIOD; ROCKS; SEDIMENTARY ROCKS; and section on *Glaciers* in article on GEOLOGY.

GLACIAL DRIFT. See DRIFT.

GLACIAL EPOCH. See GLACIAL PERIOD.

GLACIAL GEOLOGY, that branch of geology that treats of glacial phenomena both past and present. See CAMBRIAN; GEOLOGY; GLACIER; GLACIAL PERIOD; PERMIAN; PLEISTOCENE EPOCH.

GLACIAL PERIOD, or **ICE AGE.** Over nearly all of the North American continent north of the 40th parallel and over a vast tract of the continent of Europe, due to the work of moving ice sheets or glaciers, rock surfaces have been ground and polished, great boulders have been carried and deposited long distances from the ledges whence they came, and the topography has been given characteristically rounded outlines. Since the marks of the ice chisel are plainly visible on hard rocks, and even on easily weathered rocks that have been protected by a thin layer of soil, it is evident that the ice finished its work recently.

Effects of Glaciation.— At the opening of the Glacial Period most of the land surface over which the ice advanced was covered by a deep soil grading through partly decayed rock into solid rock. Undoubtedly the ice did not level off the general surface of the country as much as has been supposed, but it wiped off the soil and partly decayed rock and dumped it into the valleys, rounded the outlines of hills, broadened north and south valleys and pushed before it or carried along a mass of detritus which formed, whenever the ice stopped its advance, a terminal moraine. It is possible that clay and boulders were laid down in a thin sheet under the ice in places at least, forming what is known as boulder clay or till and near the southern edge of the ice sheet, producing oval hills of clay and boulders known as drumlins. Other deposits were formed along the edge of the ice, from material worked over by water and known as stratified drift. These deposits include irregular hills of sand, gravel and boulders, called kames, and long winding ridges of the same material called eskers. These latter are supposed to represent the filled channels of subglacial rivers. Irregular depressions known as kettle holes occur in a glaciated region where isolated masses of ice were buried as the ice sheet retreated. It is in fact in the retreat of the ice front that topography was most modified, the terminal moraines, at each pause in the retreat, dammed river valleys, while the valleys were filled sometimes to a depth of hundreds of feet with detritus. Between the morainic dams in front and the ice in the rear, great lakes were formed, one of these, Lake Agassiz in Minnesota, the Dakotas and Manitoba being 700 miles long from north to south. At the same time, the Great Lakes stood at a much higher level than now. Their outlet through the Saint Lawrence River was still blocked with ice, and they drained by various channels in part through the Chicago River to the Mississippi, in part by other outlets. At a later stage they drained through the Mohawk Valley into the Hudson River, and thence to the Atlantic Ocean. Their history has been very complex, and is traced largely in the beaches which they left. Since these beaches are not now horizontal it is known that changes of level have occurred since glacial times. As the glacial retreat was recent, streams have not had time to cut down valleys and so a glaciated region is a region of lakes.

Cause and Duration of the Glacial Period.—Though several theories of the cause of the Glacial Period have been proposed, no one has received general acceptance. The existence of Glacial periods in past geologic ages is well established. Some writers hold that northern North America and probably Scandinavia were much elevated at the close of Tertiary time and that this elevation of the land caused so heavy a snowfall that snow lay on the ground all the year round, and glaciers started. Another hypothesis, that of Croll, is that owing to variations in the eccentricity of the earth's orbit around the sun the hemisphere having winter when the earth was farthest from the sun would for a period have protracted winters, and during this period great masses of ice might accumulate. Whatever the cause, the ice sheets formed and advanced. In North America three centres of glaciation are generally recognized, the Cordilleran along the Rocky Mountains in British Columbia, whence the ice flowed eastward possibly 1,000 miles or more; the Keewatin, near Hudson Bay, whence the ice advanced southwest, south and southeast, reaching as far south as Iowa; and the Laurentide, north of the Saint Lawrence River and in Labrador, whence the ice advanced over eastern Canada, New England and the Central States as far west as the Mississippi River. The retreat of these ice sheets was accompanied or preceded by changes of level, until at the close of the Ice Age, during the so-called Champlain stage, or its equivalent, the Columbian, the ocean covered what is now dry land in the vicinity of Saint Lawrence River and Lake Champlain, and the climate was milder than now. The ice did not advance nor retreat steadily. Some geologists recognize in the Mississippi Valley four or five advances and corresponding retreats, and speak of these as epochs or stages. The time since the close of the Ice Age has been variously estimated; average estimates being around 20,000 years. There is good evidence for believing that as much time elapsed between some of the advances of the ice. Hence it is sometimes said that we may be living to-day in an Inter-glacial Period. It is certain that man was in Europe in what is known as the Chelean Epoch, or early Pleistocene. He may have been in America at the same time, but no certain evidence of his presence has been found. See COLUMBIAN FORMATION; DILUVIUM; CHAMPLAIN STAGE; DRIFT; DRUMLIN; GLACIER; TILL.

Bibliography.— Agassiz, 'Systeme Glaciale' (1847); Croll, 'Climate and Time' (1885); Dawson, 'Canadian Ice Age' (1894); Bonney, 'Ice Work, Past and Present' (1896); Geikie, 'Great Ice Age' (1895); Heim and Penck, 'On the Ancient Glaciers of the Isar and Liuth' (1886); Wright, 'Ice Age in North America' (1890); Upham, 'Glacial Lake Agassiz' (United States Geological Survey, Monograph XXV).

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GLACIER, a current of ice formed from compressed snow. Water, changed into vapor by sun-heat and carried by the winds over frosty highlands, is crystallized into snow. Glaciers take their rise in regions which lie above the snow-line. Upon these regions from their geographical position and elevation, the quantity of snow that falls exceeds the quantity melted and immediately evaporated. The surplus, instead of accumulating indefinitely, is changed by the pressure of its weight into ice, which, though hard and apparently as brittle and inflexible as glass, flows down toward the sea in beautiful swaying undulating lines, as if soft like honey or tar. Thus the overburdened regions above the snow-line are relieved and a continuous circulation is maintained,—ocean water flying away through the air in the form of vapor, but in returning creeping along the ground in the form of ice, grinding and crushing the rocks that lie in its way, and leaving a heavier track than anything else that moves on the face of the earth.

In general a glacier flows like a river, and drains off snow as a river drains off rain. At different places it moves at different rates, not only along its cross-sections, but along its length and also from surface to bottom, as friction and the declivity of its bed varies. The velocity of the swiftest parts of the largest glaciers of the Alps is about from one foot to three feet per day; of the smallest, about as many inches. The lower central part of the Muir Glacier of Alaska flows about 10 feet a day. Some of the Greenland glaciers are said to flow much faster, from 59 feet to 100 feet having been recorded for 24 hours. Glacier motion, however slow, is continuous. It is less in winter than in summer, and slightly less in frosty nights than in warm and rainy days. Differences are noted also where the neighboring peaks constrict the ice flow to a narrower path. At such points the speed is increased.

Crevasses.— Though obedient to the laws of liquid motion in general, a glacier refuses to stretch, as is shown by its breaking sharply asunder at right angles to tension strains, thus forming the so-called transversal, longitudinal, marginal and *bergschrund* crevasses. The first two are caused by unevenness of the channel, the marginal by differential motion, the *bergschrund* by the glacier flowing away from the motionless snow attached to the head of its basin. The last is of course a feature of all glaciers; so are the marginal crevasses, since the middle of all glaciers flows faster than the sides; but large central areas, where the bed is regular in slope or slightly concave, are free from crevasses. The largest crevasses are several miles long, 1,000 feet deep or more, and 30 or 40 feet wide, though at first they are usually too narrow to admit a knife-blade. In some places all sorts of crevasses are interlaced, forming labyrinths of yawning gulfs defying the skill and will of the bravest mountaineer who tries to hew a way through them. The ridges between closely spaced crevasses are known as *seracs.*

Regelation.— The brittleness of ice, with its flowing motion, is partly explained by regelation (refreezing). In 1850 Faraday discovered that when two pieces of thawing ice are placed together they freeze at the points of contact. Snow at a temperature of 32° F., stuffed into a mold and squeezed, becomes transparent ice. So also fragments of ice pressed in a mold break, are crushed and recongealed into a solid mass of the form of the mold, illustrating the breaking of glaciers and their regelation when from change of position the sides of the chasms, great or small, are pressed together.

Moraines.— The life of a glacier is one eternal grind. Its draining streams are always milky with rock mud rubbed off its bed, and separated from the large detached masses by the waters. Moraines, lateral, medial and terminal, are the general detritus of a glacier and the weathered heights about it, drawn out and arranged by the ice currents, and located as their names indicate. The medial moraines, of which each glacier usually has one fewer than the number of its tributary glaciers, are formed by the union of two laterals at the confluence of the tributaries, and extend down the trunk in beautiful order. The terminal moraine is made up of parts of all the others. The moraine material, clay, sand and boulders, of the great continental glaciers of the Ice Age, is often called drift. The detached rock masses, borne along by the ice currents and left in the terminal moraines, or if the glacier reaches the sea, dropped perhaps hundreds of miles away by iceberg, are called erratics.

The most striking features of large glaciers are the medial moraines, the lakes and streams on its surface, the wild ice cataracts corresponding to the cascades and rapids of rivers, and the discharging frontal wall, with its icebergs. Glaciers vary widely in size and form; they may be classified as follows:

(*a*) Continental glaciers, of which only two now exist, the Greenland and South Polar ice caps, dome-shaped ice deposits covering the entire face of nature beneath. Similar in character to the continental glaciers are the ice caps of Norway, Iceland and Franz Josef Land and the masses of "inland ice" (and snow) in Spitzbergen, Nova Zembla, Baffin Land, Grinnell Land and Ellesmere Land.

(*b*) Glaciers of the first order, which are more or less river-like, flow into the sea, and terminate in berg-discharging ice cliffs.

(*c*) Glaciers of the second order, which approach the sea, but do not enter it, and of course do not discharge icebergs, waste from melting and evaporation equaling the snow supply.

(*d*) Glaciers of the third order, residual branches of those of the second, separated and made independent by the melting away of the trunks to which they belonged. Nearly all the glaciers of the world are now of this order. The last three types are often called valley or alpine glaciers.

Distribution of Glaciers.— Most of the glaciers of North America are distributed along the mountain ranges of the Pacific coast from central California northward. About 65 small residual glaciers a mile or less long still linger on the Sierra Nevada of California between lat. 36° 30′ and 38°, at an elevation of 11,000 to 12,000 feet above sea-level. Groups of larger glaciers drain the snow-fields of Mount Shasta and the high volcanic mountains of the Cascade Range in Oregon and Washington. From ice-crowned Mount Rainier, 14,600 feet high, eight glaciers, 5 to 10 miles long, descend into the forests to within 3,000 and 4,000 feet of sea-level. The broad, lofty mountain chain extending along the coasts of British Columbia and southeastern Alaska is generally ice-laden; the upper branches of the main valleys are occupied by glaciers, which gradually increase in size and descend lower, up to the highest and snowiest region of Alaska between lat. 56° and 61°, where a considerable number flow into arms of the sea. This is the region of greatest glacial abundance on the continent. To the north of lat. 61° the glaciers gradually diminish in size to about lat. 62° 30′ or 63°. Beyond this, to the north end of the continent, few, if any, glaciers now exist, the ground being comparatively low and the snowfall light.

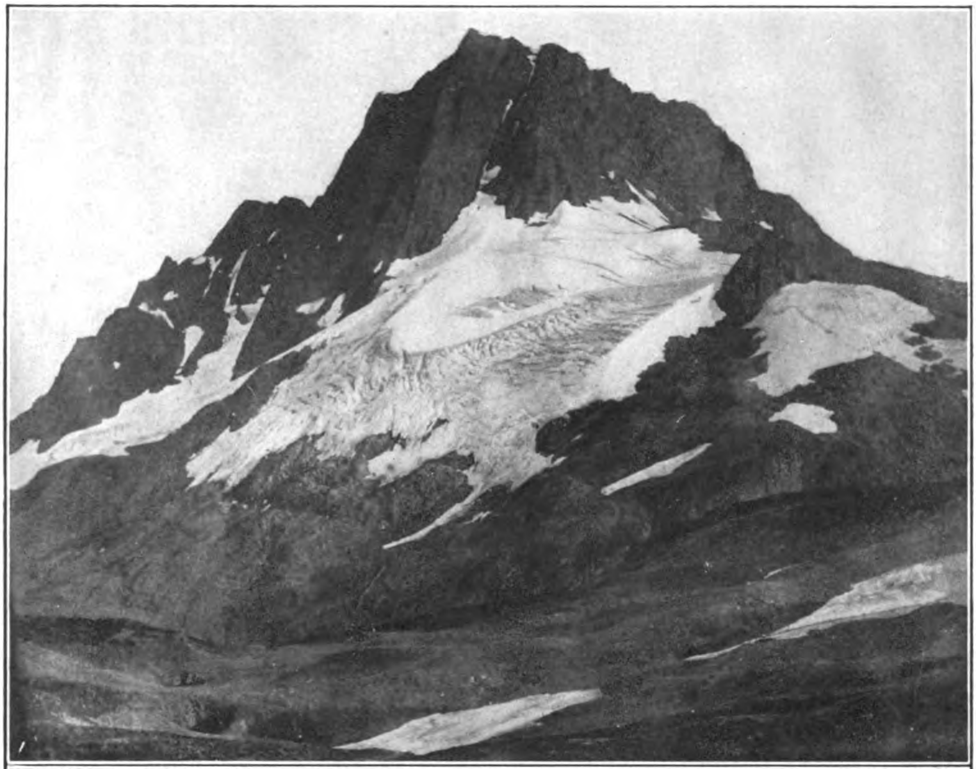
Glaciers of the third order, a mile or two to 15 or 20 miles long, fill the upper canyons and hollows of the highest region in countless thousands.

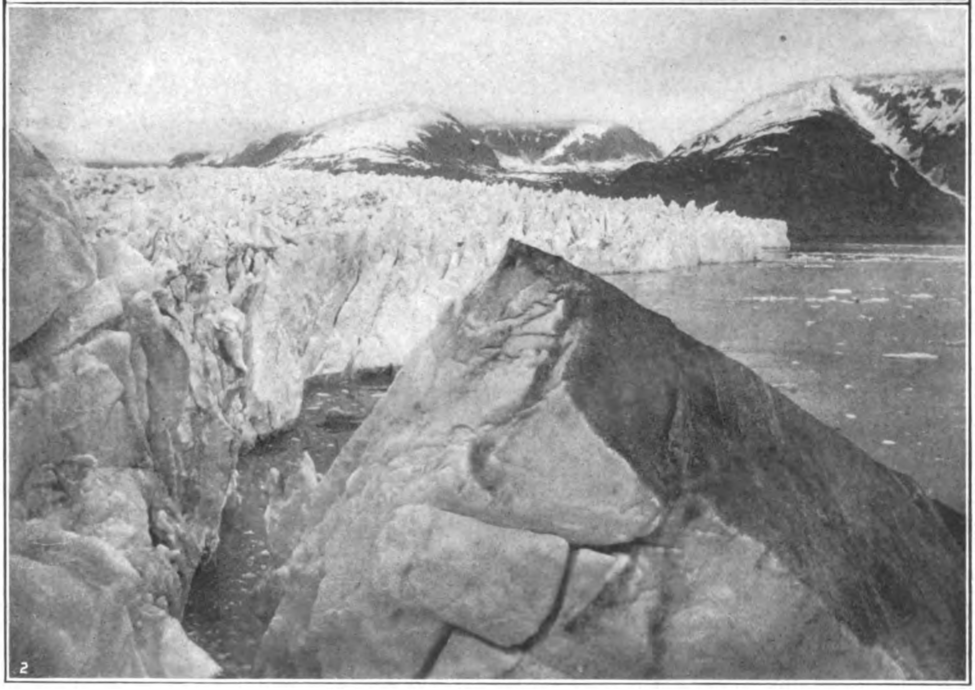
The large glaciers of the second order number about 100. They are distributed along the coast from the mouth of the Stickeen River to Cook Inlet and the Alaska Peninsula. The expanded fan-shaped ends of many of this order are from two to four or five miles wide and constitute what are known as bulb glaciers or, if very large, piedmont glaciers. The largest among these are the Malaspina Glacier, the Miles, Yakutat, Grand Plateau, Crillion and La Pérouse, fronting the sea along the Saint Elias and Fairweather mountains. The Malaspina is the largest of them all, being about 20 miles long and 65 or 70 miles wide,— a grand undulating ice prairie sloping gently from the base of the Saint Elias Mountains, and separated from the sea by a girdle of forested moraines five or six miles wide, except at Icy Cape, where it presents bluffs of pure ice that are being continually undermined by the waves and are discharging icebergs into the sea. The La Pérouse also presents ice bluffs to the open ocean, which at high tide are wave-washed, and small bergs are occasionally detached; but far the greater number terminate a mile or two from the tide line, back of moraines in rather low-spreading crevasse-gashed brows, over which one may easily climb.

The great glaciers of the first order flowing out into deep ocean water and discharging fleets of icebergs number about 31. One, the southmost, flows into the Le Conte Fiord in lat. 56° 50′, four into branches of Holkam Bay, one into Taku Fiord, nine into the Glacier Bay fiords, two into Lituya Bay at the base of Mount Fairweather, three into Disenchantment Bay and 11 into the wild fiords of Prince William Sound, the northmost being a little above the 61st parallel. The birth of icebergs from this type of glacier is attributed to the thinning of the foot of the glacier from above, and the upward force exerted by the lighter specific gravity of ice as compared with sea water at a depth of several hundred feet.

The scenery of these fiords is of the grandest description. From wall to wall they are encumbered, often jammed with icebergs, which by the most active glaciers are discharged at intervals of a few minutes with thundering roaring that may be heard 5 to 10 miles away, proclaiming the restless work and power of these mighty crystal rivers, in striking contrast with the dead silence of those of the second order, though they also, except at their decaying ends, are ceaselessly flowing and grinding.

GLACIERS

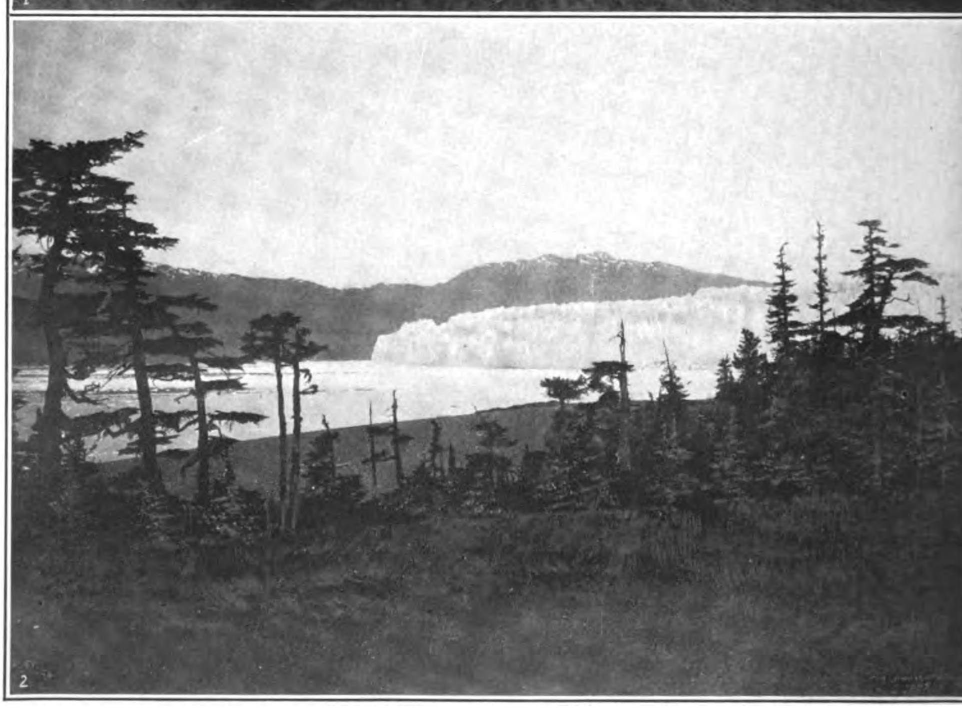




1 Hanging Glacier

2 Front of Muir Glacier

GLACIERS



1 Small Residual Glacier

2 Front of Columbia Glacier

Glacier Bay is the iciest of the inlets which fringe the coast. Both to the north and south of it the glaciers are generally less lavishly snow-fed, and of course give birth to fewer icebergs. Of its nine glaciers of the first order, the Muir is the largest. It is about 50 miles long, the main trunk below the confluence of the principal tributaries is about 25 miles wide and probably about 1,500 feet deep. The berg-discharging part of the sea-wall is less than two miles wide, rises above the water to a height of 250 to 300 feet, and sinks to a depth of about 700 feet.

The grandest of the Prince William Sound glaciers are the Columbia, Barry, Harvard, Yale and Harriman. Some of the smallest of the noble company descend flowery mountain-sides in the wildest and most imposing ice-cataracts.

Residual glaciers from a mile to 10 or 12 miles long, including névé, are distributed throughout the Rocky Mountain ranges from lat. 43° to 53°. The greater number lie between 50° and 52° 30′ at the heads of the Saskatchewan, Athabasca and Columbia rivers. The largest groups are magnificent rags and patches of an ancient ice-sheet, some of them covering an area of 40 to nearlv 100 square miles and sending down river-like glaciers six to eight miles long.

Glaciers of the third order abound on the Alps, the Pyrenees, the Caucasus, the Scandinavian Peninsula, the Andes, the lofty snowy ranges of Asia and on the mountains of New Zealand.

More than 1,000 with an area of about 1,200 square miles have been surveyed and named in the Alps. The largest are river-like, 10 to 15 miles long, descend into the forests and terminate at an elevation of 4,000 to 6,000 feet. Most of the smaller ones are like masses of pure snow, and terminate about 2,000 feet higher.

The Caucasus is perhaps about as heavily ice-laden as the Alps. Few of its glaciers are known to descend much lower than 6,000 and 7,000 feet. Those of the Pyrenees are comparatively small.

Many of the glaciers of Norway pour grandly down from extensive névé fields to within 1,000 feet of the sea-level. A few approach the shore and may rank as glaciers of the second order, while one, the only one in Europe of the first order, discharges into Jokul Fiord, near the 70th parallel. Between the larger glaciers flowing toward the heads of the fiords there are many hanging and cascading glaciers, ranged along the brows of plateaus, some of which pour over precipices in separate bergs with loud roaring like that of glaciers discharging into the sea. At the foot of the cliffs the battered fragments are welded by the accumulating weight and thus these wild ice-streams, after their plunge through the air, are made whole again and flow quietly on their way as «regenerated glaciers,» the space between their upper and lower parts being only a wider and more complete crevasse.

The low-descending New Zealand glaciers almost rival those of the Alps in size, while their beauty is greatly enhanced by the rich vegetation through which they flow.

The glaciers of South America are distributed along almost the whole extent of the Andes. According to Whymper those under the equator attain their greatest size on the snow-laden, storm-beaten summits of Antisana, Cayambe and Chimborazo. On Cayambe 12 glaciers of considerable size were counted, flowing from the central névé reservoir, descending to about 15,000 feet above sea-level. To the south of lat. 46° many approach the sea.

On the lofty mountain chains of Asia, especially the snowy Himalaya, Karakoram, Hindu-Kush, Kuen-Lun and Thian-Shan, thousands of little known residual glaciers still exist. The largest which have been explored are the magnificent Biafo and Baltoro Karakoram glaciers, 30 and 35 miles long, descending to about 11,500 and 12,000 feet.

Excepting Australia, which seems to have lost all its glaciers, Africa is glacially the poorest of the continents. Its only known glaciers are those of the two great snowy mountains, Kenia and Killimanjara, near the equator.

The Arctic islands — Jan Mayen, Nova Zembla, Spitzbergen, Franz-Joseph Land and many others — are heavily ice-laden. Their largest glaciers are broad sheets discharging magnificent bergs into the frozen sea.

But it is on Greenland and the South Polar lands that glacier ice reaches its grandest development. Excepting a narrow interrupted strip around its shores, Greenland lies buried beneath a continuous mantle of ice thousands of feet in thickness, through which only the rock tops of its highest peaks, called «nunataks,» protrude. From this ice-cap huge glaciers pour into the sea, discharging icebergs of enormous dimensions, some of which sail into the Atlantic thousands of miles from home.

Still greater is the South Polar ice-cap, probably over two miles in thickness. The sea front of some of the glacier currents it pours forth are from 100 to over 400 miles wide, from which flat-topped island-like icebergs 5 to 10 miles long are discharged. Here the great cosmical winter of the Glacial Period still exists in severe, serene grandeur.

Greater Extension of Glaciers.— That a great part of the earth in both the northern and southern hemispheres, now warm and fruitful, was recently covered by flowing, grinding ice, is well known. Over the eastern half of North America from the Arctic regions to lat. 40° or lower, moraines and beds of moraine material variously modified, grooved, scored and polished surfaces, with other characteristic traces of glacial action, are displayed in wonderful abundance and uniformity.

Along the mountain ranges of the west side of the continent they extend still farther south. The broad Rocky Mountain chain and the plains along its flanks abound in glacial traces on a grand scale. On the Sierra Nevada polished and striated rock surfaces, the most evanescent of glacier inscriptions may still be found as far south as lat. 36°; while a degree or two farther north, at an elevation of 7,000 to 8,000 feet above the sea, there are broad glacier pavements in so perfect a state of preservation that they reflect the sunbeams like glass and attract the attention of every observer.

Over the greater part of Oregon, Washington, British Columbia and the Arctic and sub-Arctic regions about Bering Sea and northwestern Alaska, the rocks in general are less resisting, and the weathering they have been subjected to is more destructive. Therefore the superficial records of glaciation are less clear in these northern regions than in California.

But in all glaciated regions there are other monuments of ice action which endure for tens of thousands of years after the simpler traces we have been considering have vanished. These are the sculpture and configuration of the landscape in general,— the canyons, valleys, fiords, mountains, ridges and *roches moutonnées,* the forms, trends and correlations of which are specifically glacial and almost imperishable. These also, it is true, suffer incessant waste, being constantly written upon by other agents. But because they are so colossal in size and peculiar in form and arrangement they continue to stand out clear and telling through every after-inscription, showing how great the ancient glaciers must have been, and how great are the geographical and topographical changes they have produced. Where man is busiest, even in the parks and gardens of New York, glaciated rocks shine and call attention to the story of the Ice Period; and in orchards growing on moraine soil around the town of Victoria on the west side of the continent, fruitful boughs drop apples and peaches on the edges of glacier pavements, while the harbor rocks are still bright notwithstanding the centuries of wave-action they have been subject to.

Only yesterday, so to speak, much of our continent was buried under a dreary expanse of ice, as Greenland is to-day. It has left its trace in lake and swamp, in polished outcrop and rounded hill, in countless islands and fringing fiords. Under the influence, however, of a gradually warming climate, the glaciers have wasted away into insignificant remnants. See GLACIAL PERIOD; PLEISTOCENE EPOCH; GEOLOGY.

Bibliography.— Agassiz, L., 'Systeme Glaciale' (Paris 1847); Arctowski, H., 'Les Glaciers' (Antwerp 1908); and 'Die Antarktischen Eisverhältniese' (Gotha 1903); Bonney, T. G., 'Ice Work, Past and Present' (New York 1896); Forbes, J. D., 'Travels in the Alps' (Edinburgh 1845); and 'Norway and Its Glaciers' (Edinburgh 1853); Geikie, J., 'The Great Ice Age' (New York 1895); Gilbert, G. K., 'The Harriman Alaska Expedition' (1904); Harper, A. P., 'Pioneer Work in the Alps of New Zealand' (London 1896); Heim, A., 'Handbuch der Gletscherkunde' (Stuttgart 1885); Hobbs, W. H., 'Characteristics of Existing Glaciers' (New York 1911); Larden, W., 'Argentine Plains and Andine Glaciers' (London 1911); Matthes, F. E., 'Mount Rainier and its Glaciers' (United States Interior Department 1914); Meyer, H., 'Across East African Glaciers' (London 1891); Russell, I. C., 'Glaciers of North America' (Boston 1897); Scott, R. S., 'The Great Ice Barrier and the Inland Ice'— Antarctic (Geographical Journal, London, Vol. 46, pp. 436–447, 1915); Sherzer, W. H., 'Glaciers of the Canadian Rockies and Selkirks' (Smithsonian Institution 1907); Tarr, R. S., and Martin, L., 'Alaskan Glacier Studies' (Washington 1914); Tyndall J., 'Glaciers of the Alps' (Boston 1861); Wright, G. F., 'The Ice Age in North America' (New York 1902), and 'Man and the Glacial Period'; Wright, W. B., 'The Quaternary Ice Age'; *Zeitschrift für Gletscherkunde* (Berlin 1893 to date).

GLACIER BAY, Alaska, a fiord 60 miles long north of Icy Strait. It extends in a northerly direction through the Saint Elias Mountains which discharge several glaciers into it. The Muir Glacier is the largest, being three miles broad at the sea and about 200 feet high. Its area is 1,250 square miles, or about that of the State of Rhode Island. The bay is so encumbered with ice that navigation there is attended with considerable danger.

GLACIER BEAR, a small gray or "blue" bear (*Ursus emmonsi*) of the Saint Elias Alps, Alaska. See BEARS.

GLACIER NATIONAL PARK, The, a public park set aside by presidential proclamation pursuant to authority conferred by the act of 11 May 1910. It lies just south of the Canadian line, including portions of Teton and Flathead counties, Mont. It includes that part of the front range of the Rocky Mountains in Montana. In shape it is an irregular rectangle. On the west it is bounded by the north fork of Flathead River, on the south by the middle fork of Flathead River and the Great Northern Railroad and on the east by the Blackfeet Indian Reservation. The Continental Divide extends through the park from northwest to southeast. The eastern face is precipitous. Long ridges or shoulders extend from the Divide westward. This mountain chain is not a single narrow ridge, as may be assumed from its appearance at a distance, but is many miles in width, varying from 18 to 25 miles, and consists of a network of ridges and high spurs. The mountain mass has been regarded as two distinct ranges, the Livingston range on the west, and the Lewis range on the east. The Continental Divide joins the two ranges at Flattop Mountain by a low pass. The park covers 915,000 acres, or about 1,450 square miles. The greatest length at any place of the irregular outline is about 45 miles. The greatest width is along the Canadian-United States boundary line, nearly 35 miles. There are about 80 glaciers between five square miles and a few acres in area. These glaciers, scattered throughout the area, give the name to the park. There are about 250 lakes, from those covering a few acres to those of larger size, several miles in length. The lakes are surrounded by steep and beautiful mountains. One of the interesting features of the park is the peculiarly rugged topography, the abrupt mountains in this part of the range being largely in the park area. There are mountains with vertical walls from a few hundred to more than 4,000 feet in height. Glaciers are perched high along the range in protected places, with waterfalls and cascades from a few feet to 2,500 feet. The western slope of the mountains is gradual and covered with timber, while the eastern face is abrupt. One passes at once from the rugged peaks, glaciers and waterfalls to the smooth, treeless, glaciated plains. The high summits are not regularly arranged, some occurring in the Continental Divide, others on the spurs projecting from either side. While the mountains are not high they rise from low plain or valley, 3,153 feet elevation at Lake McDonald and 4,186 at Waterton Lake on the north. They rise to heights of over 10,000 feet, with imposing grandeur. The peaks rising more than 10,000 feet above the sea are Mount Cleveland,

1 Lake Ellen Wilson and Gunsight Pass, from the trail

2 Looking west from Going-to-the-Sun Chalet

10,438; Mount Stimpson, 10,155; Kintla Peak, 10,100; Mount Jackson, 10,023; Mount Siveh, 10,004. The Garden Wall is a name applied to the stupendous portion of the Divide between Swift Current Pass and Gould Mountain, above Grinnell Glacier. This portion of the mountains is of marvelous beauty and grandeur. Other precipitous walls of great height are seen on the way from Saint Mary Lake to Lake Ellen Wilson on the trail over Gunsight Pass. At Triple Divide Peak the water flows from its sides into three oceans through Norris Creek and Saint Mary Lake to Hudson Bay and the Arctic; through Cut Bank Creek into the Missouri and the Gulf of Mexico; and through Nyack Creek into Flathead River, thence to Clark's Fork of the Columbia River and the Pacific. The abruptness, beauty and magnificence of the mountains have been produced by uplifting and faulting of the rocks. Breaking in the rock strata in a number of places occurred, and the rocks on the west side of the folds were pushed upward and eastward over the then surface rocks. The mountain rocks were shoved over the rocks of the plains, producing an overthrust fault. Through these hard and precipitous cliffs streams have cut through the overthrust mass and down into the soft rocks of the plains. This overthrust fault may readily be traced on the surface, as it makes an irregular zigzag from spur to valley. This thrust has been traced through and beyond the park in either direction. The full extent is not yet determined, but in one place the rocks have been shoved over the underlying former surface a distance of 15 miles, the direction being northeast. Streams and glaciation have carved the mountains in later times.

Of the 250 lakes of the park about 50 are large enough to command more or less attention. Lake McDonald is perhaps best known. Its lower end is but a short distance from the Belton entrance to the park. Saint Mary Lake (upper) is the first park point touched by travelers from the Glacier Park (station) entrance. Three lakes with name Two Medicine retain that Indian name. Hidden Lake lies high in the almost inaccessible mountains. Grinnell and Gunsight lakes lie at the foot of mountains of the same name. Waterton is partly in the park, partly in Canada on the north. Iceberg Lake, visited without difficulty, lies at the foot of a 3,000-foot cliff on the north side of Mount Wilbur. Kintla lakes are in the northwestern part, as yet rarely visited by the tourist or traveler. Avalanche Lake lies below the shoulder on which is Sperry Glacier. Bowman, Quarts, Logging and Trout lakes, all of elongated form, are on the western slope between high ridges. The many smaller unnamed lakes in various parts of the park, and some that formerly had names, have been given names of women, as Sue, Helen, Janot, Isabel, Lena, etc.

The depths of a number of the lakes have been determined. They are usually deepest at the upper end. Although formerly supposed to be "bottomless" they are not as deep as reports would indicate, as seen from the following: Lake McDonald, 387 feet; Avalanche, 63 feet; Bowman, lower end, 90 feet; Waterton, 317 feet; Haunted Lake (Janot Lake), 10 feet; Dixon (Francis Lake), 75 feet; McDermott, 36 feet; Iceberg, 149 feet; Saint Mary (upper), 200 feet; Gunsight, 63 feet; Louise (Ellen Wilson Lake), 244 feet; Peary, at upper end of Sperry trial, 32 feet; upper Two-Medicine, 65 feet; Red Eagle, 58 feet.

Many of the lakes are without fish, due to high falls below the lakes. Gunsight and upper Two-Medicine were stocked by David Ross of Kalispell in 1915, and in 1916 he also stocked McDermott, Josephine, Grinnell and Ellen Wilson. The larger lakes are accessible for fish and are well stocked. The park glaciers are but remnants of the larger ice masses which in former ages extended far into or over the valley on the east and down the stream and river valleys on the western slopes. Of the number previously mentioned only a few are of special importance. Sperry is easiest to reach. In a day from Lake McDonald one may reach the glacier, spend a couple of hours on the ice and return. Sperry is probably three-quarters of a mile long and over a half-mile wide, much crevassed toward the lower edge. Blackfeet Glacier is the largest. Blackfeet and Red Eagle on the north or Hudson Bay side, and Harrison and Pompelly on the south or Pacific side of the Continental Divide, are really one continuous mass of ice. They extend along the Divide for more than three and a half miles, and cover a surface of between 5 and 10 square miles with solid ice of unknown depth. Blackfeet Glacier is easily reached from Gunsight Lake. The most imposing glacier and the one most difficult to reach is Harrison. It seems to barely hang on the steep side of Mount Jackson. Grinnell Glacier covers less than a square mile. It rests on a steep shelf at the foot of the Garden Wall and between Grinnell and Gould Mountains, both of which are magnificent park features. This glacier is one of the beautiful natural objects of the park. It is reached either from Grinnell Lake or from Granite Park, and without special trouble. Chaney Glacier lies high on the Divide, Hudson Bay side, but can be reached quite readily from the main trail over Flattop Mountain. It is not large, perhaps a half mile in extent in any direction, and flanks the precipitous walls of Mount Merritt. The trail over Swift Current Pass gives a fine view of the small but wonderfully beautiful Swift Current Glacier. Kintla and Agassiz glaciers, on Kintla and Kinnerty peaks, are high up and difficult to reach, and are also in a portion of the park seldom visited, the high mountains near the northern boundary. Rainbow and Vulture glaciers are of considerable size but rarely visited. The original trails in the park were made by hunters, surveyors, prospectors and Indians, and were in many cases the poorest kind of passageways. They were steep, boggy, narrow and dangerous at times and in places. Since the establishment of the section as a park the trails have been vastly improved. They are now easily traversed, are wide, have low grade and are well walled and bridged. New trails are being built annually.

Glacier Park is a wonderland of mountain crags, dizzy cliffs, dashing waterfalls, clear lakes, eternal snow and ice, primæval forests, wild game, blue sky and brilliant sunshine. Here the works of Nature have not been marred by the hand of man.

Morton J. Elrod,
Director of Biological Station, University of Montana.

GLACIO-FLUVIAL DEPOSITS, those deposits of glacial origin which have been laid down by waters from the melting ice. They are characteristically stratified and are often called stratified or modified drift. Eskers, kames, outwash plains and valley trains afford the most common examples. See ESKERS, GEOLOGY, KAME, etc.

GLACIOLOGY. See GLACIAL GEOLOGY.

GLACKENS, William J., American artist: b. Philadelphia, Pa., 13 March 1870. He was educated in the public schools, the Pennsylvania Academy of the Fine Arts and also studied in Europe. He exhibited at the Paris Salon of 1896 and at the Paris Exposition of 1900. In 1901 he was awarded a gold medal at the Buffalo Exposition and three years later his work won silver and bronze medals at the Saint Louis Exposition. In 1906 he was made associate of the National Academy and is also member of the Society of American Illustrators and the Society of American Painters and Sculptors. His best-known works are 'May Day Party' and 'Girls Bathing' (1911). He has been successful in portraiture, landscape and figure drawing, his work impressing with its gift of spontaneity. Especially noteworthy was his tableau representing 'Russia,' one of the most striking of those produced by leading artists who volunteered their services in the decoration of the Avenue of the Allies, New York, during the campaigns for raising the loans to carry on the war against Germany.

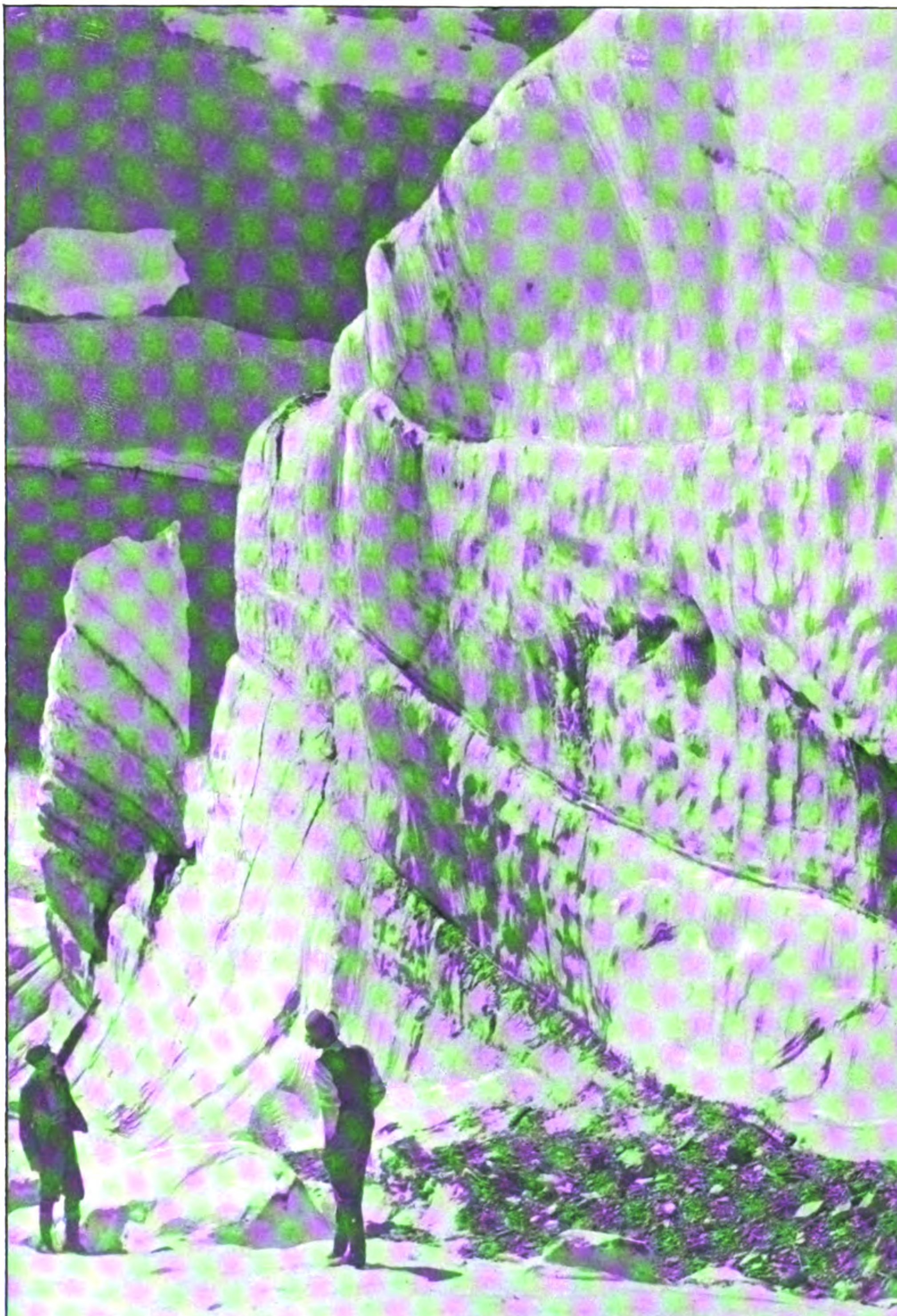
GLADBACH, gläd'bäн, or **BERGISCH-GLADBACH,** Prussia, town of the Rhine Province, 10 miles northeast of Cologne. It has manufactures of paper, cigars, lumber, dyewood, dyes, iron ore and metal products, fire clay and powder. Pop. 15,200.

GLADBACH, or **MÜNCHEN-GLADBACH,** Prussia, town of the Rhine Province, 15 miles west of Düsseldorf. It contains a fine 12th century church, the Münster-kirche, several monasteries and a teacher's training school. It has manufactures of silk, cotton and woolen goods, dyes, thread, shoes, candies, wagons, leather, paper, furniture, brick, machinery, ropes, etc. The town grew up about the Benedictine monastery, founded here in the 8th century and suppressed in 1800. Pop. 67,000.

GLADDEN, Washington, American Congregational clergyman: b. Pottsgrove, Pa., 11 Feb. 1836; d. Columbus, Ohio, 2 July 1918. He was graduated at Williams College in 1859; ordained in the Congregational Church, and after several other pastorates became pastor of the First Congregational Church in Columbus, Ohio, in 1882; in 1914 he was made pastor emeritus. From 1904 to 1907 he was moderator of the National Council of Congregational Churches. He was widely known as a writer on social reforms. In 1905 Dr. Gladden led a fearless attack on "tainted money." It began when John D. Rockefeller offered the American Board of Commissioners for Foreign Missions of the Congregational Church $100,000 for its work in converting heathens. In opposing this gift Dr. Gladden characterized it all ill-gotten wealth and unfit for Christian use. "If the Church unfits itself for work by taking bribes of tainted money," he said, "she ought to perish with the money, and she will." His uncompromising stand resulted in a widespread controversy, and although he was overruled by the board of missions, Dr. Gladden continued his fight against his Church forming close relations with "predatory wealth." As a reformer he entered politics and was elected a member of the city council of Columbus. He wrote many notable works on religion, several poems and hymns and on social reform. The include 'Plain Thoughts on the Art of Living' (1868); 'Workingmen and Their Employers' (1876); 'The Christian League of Connecticut' (1883); 'Things New and Old' (1884); 'The Young Men and the Churches' (1885); 'Applied Christianity' (1887); 'Parish Problems' (1888); 'Burning Questions' (1889); 'Who Wrote the Bible' (1891); 'Tools and the Man' (1893); 'Social Facts and Forces' (1897); 'Art and Morality' (1897); 'The Christian Pastor' (1898); 'How much is Left of the Old Doctrine' (1899); 'Straight Shots at Young Men' (1900); 'Social Salvation' (1901); 'The Practise of Immortality' (1901); 'Witnesses of the Light' (1903); 'Where does the Sky Begin?' (1904); 'Christianity and Socialisms' (1905); 'The New Idolatry' (1905); 'The Church and Modern Life' (1908); 'Recollections' (1909); 'The Labor Question' (1911); 'Ultima Veritas' (1912); 'Present Day Theology' (1913); 'Live and Learn' (1914); 'Commencement Days' (1916).

GLADHEIM, gläd'hīm, in north European mythology, the last dwelling-place of Odin, the heaven of all things, containing the hall of heroes (Valhalla). It has a ceiling of spears, a roof of shields and seats covered with armor. In the 'Elder Edda' it is said to have upward of 500 gates, through each of which it is possible for 800 men to enter abreast.

GLADIATORS (Lat. "swordsmen"), combatants who fought at public games in Rome for the entertainment of the spectators. Gladiators were first exhibited at Rome in 264 B.C., by Marcus and Decimus Brutus at the funeral of their father; and the custom probably originated in Etruria, where a slave was killed at his master's pyre. In the course of time the shows, begun as part of funeral rites, became a popular amusement, and gladiators also fought at public festivals and other entertainments. They were at first prisoners, slaves or condemned criminals; but afterward freemen fought in the arena, either for hire or from choice. Under the empire persons of senatorial rank, and even women, fought in the arena. One of the most celebrated of these shows was given by the Emperor Trajan, when 5,000 gladiators fought in the arena. Attempts were made to limit them as a danger to the public peace. The regular gladiators were instructed in schools ("ludi") established for this purpose. The overseer of the school ("lanista") purchased the gladiators, trained them and rented them to those who gave games to the people. Men of position, especially such as aimed at popularity, sometimes kept gladiatorial schools of their own and hired lanistæ to instruct them. The gladiators fought in the schools with wooden swords. The games were commenced by a "prælusio," in which the combatants fought with their weapons of wood till, upon a signal,



GLACIER NATIONAL PARK

Huge Glacier formed from snow banks that thaw enough to soften and then freeze into glacial ice

they assumed their arms and began in earnest to fight in pairs. In case the vanquished was not killed in the combat, his fate was decided by the people. If they decreed his death, the thumb was held up in the air; the waving of handkerchiefs was the signal to save him. In general they suffered death with wonderful composure, and the vanquished often exposed himself to the death-blow. If he wished to appeal to the people he raised his hand. When a gladiator was killed attendants dragged his body away with iron hooks. The gladiators were often released from further service and presented with wooden swords as badges of freedom, from which they were called «rudiarii.» The gladiators were divided into classes, according to their mode of fighting: the «andabatæ» fought blindfolded; the «catervarii» fought in troops; the «essedarii» fought in chariots, like the Gauls and Britons. Other classes were the «retiarii,» armed with net and trident but unprotected by any armor, their usual opponents being armed as Gauls and styled «mirmillones.»

The most celebrated gladiatorial statues are: (1) The Gladiator Borghese, a combatant with extended arm in the act of warding off a blow. It is a statue of the first rank, made of fine grained marble, and is now in the capitol, to which it was restored from Paris in 1815. (2) The Dying Gladiator, purchased from the Ludovisian collection for the Museum Capitolinum. It is a dying warrior and not a gladiator, probably, to judge by his «torques» or twisted necklace, a Gaul who is wounded and is trying to rise. Consult Friedländer, 'Roman Life and Manners in the Early Empire' (New York 1909).

GLADIOLUS, glā-dī'ō-lŭs (Lat. «a small sword»), a genus of plants of the family *Iridaceæ*. It received its name from the shape of its leaves. It has bulbous rhizomes, and the stems are leafy and bear beautiful flowers which, in garden culture, open in midsummer. There are about 160 species, some of them natives of southern Europe, the greater number being found in South Africa. Gladiolus is largely cultivated in the United States as an ornamental plant, and Long Island, N. Y., has important fields of it.

GLADSTONE, Herbert John, 1st Viscount, English statesman: b. London, 7 Jan. 1854. He was educated at Eton and Oxford. He was secretary to his father 1880–1901; under-secretary home office 1892–94; first commissioner of works 1894–95; and Secretary of State for Home Affairs 1905–09; and first governor-general of South Africa 1909–14. He sat in Parliament for Leeds 1880–85, and for Leeds West from 1885–1909.

GLADSTONE, John Hall, English scientist: b. London 1827; d. 6 Oct. 1902. He was Fullerian professor of chemistry at the Royal Institution 1874–77. As a member of the London school board 1873–94, he rendered admirable service to the cause of education. He published 'Life of Michael Faraday' (1872); 'Spelling Reform from an Educational Point of View' (1878); 'Chemistry of Secondary Batteries' (1883).

GLADSTONE, William Ewart, British statesman, orator and author: b. Liverpool, 29 Dec. 1809; d. Hawarden, England, 19 May 1898. He was of purely Scottish ancestry, the fourth son of John (afterward Sir John) Gladstone, a merchant of Liverpool and member of Parliament for the city, by his second wife, Anne, daughter of Andrew Robertson, of Stornoway. He was educated at Eton and at Christ Church, Oxford. He greatly impressed his contemporaries at school and college by his earnestness and piety, was president of the Oxford Union, and made his first notable speech before that society in opposition to the Reform Bill. As nominee of the Duke of Rutland, he was returned in the Conservative interest for the ducal burgh of Newark on 13 Dec. 1832. His maiden speech was in vindication of his father's treatment of his slaves in Demerara. On 26 Dec. 1834 he was appointed one of the junior lords of the treasury under Sir Robert Peel, and in the following year was for a few months under secretary for the colonies. In 1838 he published a volume that aroused some controversy, 'The State in its Relations with the Church,' which showed its writer to be at that time a zealous church-and-state man. On 25 July 1839 he married Catherine Glynne, the elder daughter of Sir Stephen Glynne. On the accession of Peel to office in September 1841 he became vice-president of the Board of Trade and president in May 1843. In January 1845 he resigned office on what was regarded at the time as the quite inadequate ground that the proposed increased grant to the Catholic College of Maynooth was inconsistent with his views as expressed in 'The State in its Relations with the Church.' He returned to office in December of the same year as Secretary of State for the Colonies. His appointment as Colonial Secretary necessitated his re-election for Newark; he resigned his seat, but did not seek re-election, and as a consequence was not in the House of Commons during the eventful session when the great battle for free trade was fought and won. But he rendered magnificent service to Peel in preparing and adjusting the new fiscal arrangements — a work of extraordinary difficulty. On the defeat of Peel shortly after the triumph of free trade, he vacated office.

Up to the time of the abolition of the corn laws, or at least until the movement for their abolition, Gladstone had been regarded as the «rising hope of the stern, unbending Tories,» and was regarded as in sympathy with that party for years after. In 1847 he was returned as one of the members for Oxford University. He visited Italy in 1849, and in 1851 he startled the whole civilized world by the terrible description he gave of the condition of the prisons of Naples, under the king who was known by the nickname of «Bomba,» and the cruelties which were inflicted on political prisoners. His disclosures and the denunciations with which he accompanied them helped to prepare the way for the revolutionary movement in Italy and the establishment of the kingdom of Italy.

The death of Sir Robert Peel in 1850 raised Gladstone to a commanding position in the House of Commons, and from that time may be said to have dated his almost unrivalled parliamentary eminence. An unpremeditated reply to Disraeli on the budget of 1852 was followed by the defeat and resignation of the Derby ministry. In the coalition of Whigs and

Peelites that then came into office under Lord Aberdeen, Gladstone was Chancellor of the Exchequer. His budget of 1853 marked an epoch in finance, and the speech in which it was introduced was one of the greatest of its kind ever made in the House of Commons. He imposed for the first time a succession duty, the preparation of which, he afterward declared, was the most laborious task he ever undertook. He also proposed the extinguishing of the income tax after an interval of seven years; but the breaking out of the Crimean War intervened to prevent this from being done.

The Crimean War also broke up the coalition ministry. A motion by Roebuck for an inquiry into the condition of the army before Sebastopol was carried by a large majority against the government. Lord Aberdeen at once resigned. Lord Palmerston was the one indispensable man, and he became Prime Minister. Gladstone gave the government of Lord Palmerston a general support until after the attempt of Orsini on the life of the Emperor Napoleon III in 1858, when Palmerston introduced his ill-fated Conspiracy to Murder Bill. The government was defeated, Lord Palmerston resigned, and Lord Derby was called on to form a new ministry. Under Derby, Gladstone undertook a special commission to the Ionian Islands.

The year 1859 saw Lord Palmerston back again in office and Gladstone as Chancellor of the Exchequer. The budget of 1860 was remarkable for its repeal of the paper duties, which passed the House of Lords in the following year; and for the conclusion of a commercial treaty with France. In the general election of 1865 Gladstone was defeated in Oxford University and returned for South Lancashire. The death of Lord Palmerston in 1865 called Lord Russell to the position of Prime Minister. Gladstone's mind had long been turning in the direction of an extension or rather expansion of the suffrage. The bill he proposed was defeated (1866), but when Disraeli came into office he "dished the Whigs" by introducing a reform bill of his own, which was practically a measure of household suffrage for cities and boroughs.

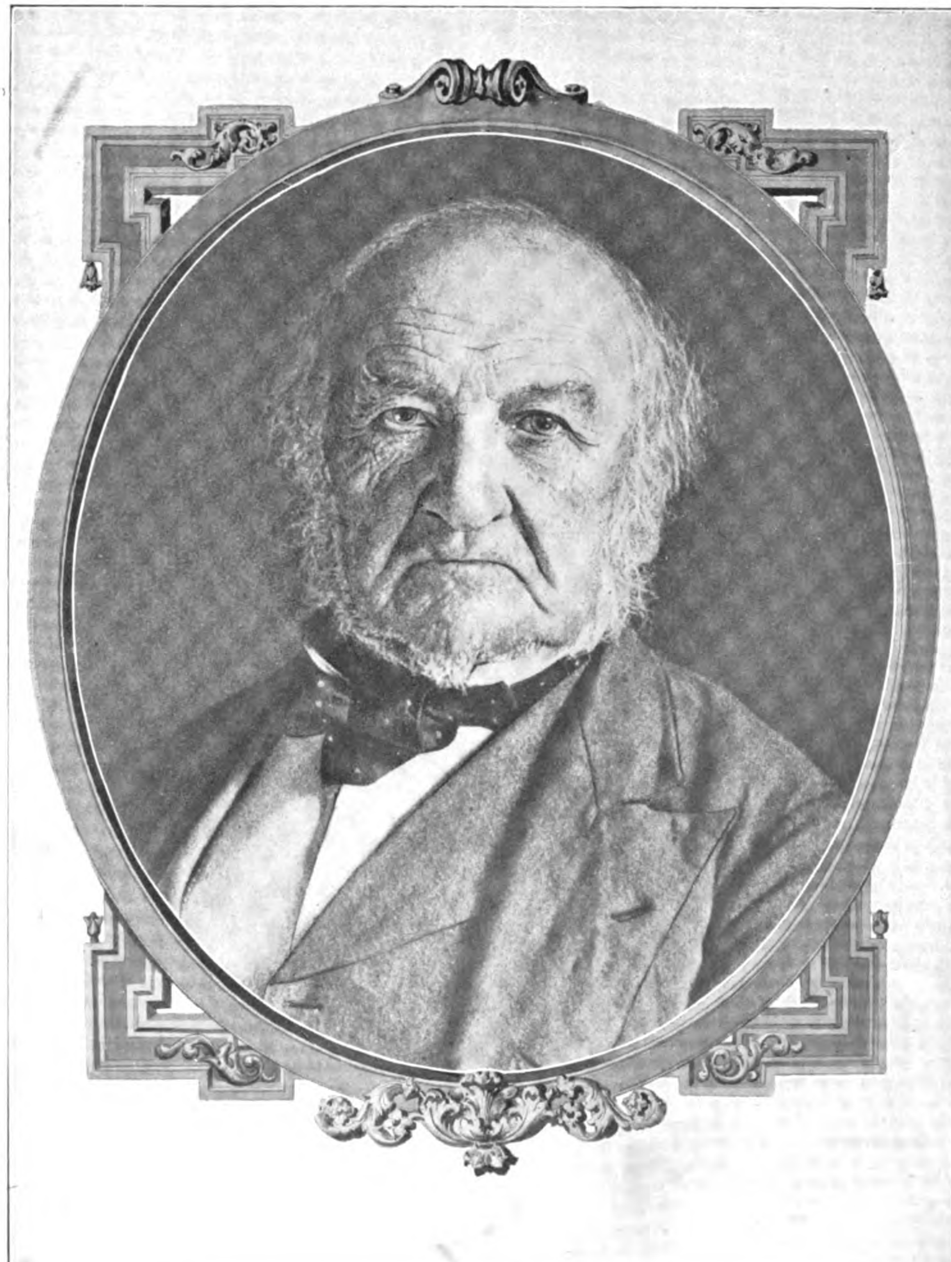
At Christmas 1867 Earl Russell died, and Gladstone became the leader of the Liberal party. About this time his attention began to be attracted to Ireland. He determined that the time had come for the disestablishment of the Episcopal State Church in that country. He defeated the government on a series of resolutions foreshadowing his policy; and the ensuing appeal to the country resulted in the return to power of the Liberals by a large majority, and Gladstone, who had been defeated in South Lancashire, but was returned for Greenwich, became Prime Minister (1868). In his first session he accomplished his purpose of disestablishing and disendowing the State Church in Ireland. This Parliament was fruitful in important reforms. In 1870 Gladstone began the first of a series of ameliorative measures dealing with the Irish land question. Patronage was abolished in the public service; the system of purchase of commissions was abolished in the army, as were also religious tests in the universities; for the first time in England a national system of elementary education was established, and voting by ballot was introduced. There is also standing to his credit the submission of the *Alabama* claims to arbitration,— and that too by one who had supported the national status of the Confederate States. A measure introduced in 1873, which aimed at establishing an Irish university acceptable to both Roman Catholics and Protestants, failed to pass, and shortly thereafter his government resigned office (1874). Disraeli was returned to power, and in the following year Gladstone formally resigned the leadership of the Liberal party.

For a time he occupied himself with those literary and historical studies that were always dear to him; but the outbreak of the Bulgarian atrocities in 1875 stirred him to indignant protest. The foreign policy of the Disraeli government was afterward subjected to severe criticism, especially in so far as it aimed at bolstering up Turkish power in Europe. He was invited to stand for the county of Midlothian, and delivered a series of speeches throughout 1879 and the spring of 1880 that destroyed the popularity of the Disraeli government, was returned triumphantly for Midlothian, and again brought back to power.

It was an unpropitious hour at which to return to office. In Afghanistan and in South Africa the Beaconsfield government had left behind a legacy of troubles; an agrarian revolution had begun in Ireland, and there the Home Rule party was under the resolute and uncompromising leadership of Parnell. Much as Gladstone abhorred the widening of imperial obligations, his government had to intervene to restore order in Egypt; the successes of the Mahdi in the Sudan and what looked like the desertion of General Gordon, followed by his death at Khartoum, told heavily against the prestige of the ministry. In Ireland, a Land Act was followed by agrarian outrages and boycotting; by a coercion act; the assassination of the chief secretary and the under secretary; and by the imprisonment of Irish leaders. The practice of obstruction was reduced to a fine art by the Irish members in the House of Commons, and feeling between them and the Liberal government became very embittered. In June 1885 the government was defeated on the budget; Lord Salisbury assumed office; and in an election that followed shortly thereafter, on a franchise which for the first time gave household suffrage to the counties, the balance of power was in the hands of the Irish members.

Then followed a dramatic change. Mr. Gladstone had appealed to the country to give him a majority that would make him independent of the Irish vote, and the Irish vote had been cast against the Liberal candidates in Great Britain; but he determined to accept the constitutionally expressed verdict of Ireland, which had returned 87 Home Rulers out of a total of 103 members, and to give Home Rule for Ireland a place on the Liberal program.

Early in 1886 the Salisbury government was defeated, and Gladstone for the third time became Prime Minister. His announcement that he intended to introduce a Home Rule bill at once produced a cleavage in his own party; Whigs like Lord Hartington and Goschen were joined by Radicals like Chamberlain and Bright, and on the second reading of the bill it was defeated by a majority of 30. The general



WILLIAM EWART GLADSTONE

election following resulted in a great majority for the Unionist party. It was not till 1892 that the veteran statesman resumed the reins of power with a majority of 40 at his back. He promptly brought in another Home Rule bill, which was passed by the House of Commons but rejected by the House of Lords. On 4 March 1894, Gladstone, on whom the weight of years was beginning heavily to tell, resigned office, and was succeeded by Lord Rosebery. He still took an interest in public affairs, and busied himself with library studies. In 1894 and 1895 he was roused to indignation by the outrages committed by the Turks on the Armenians, and spoke with something of his old power at a series of public meetings. In January 1898 he published his reminiscences of Arthur Hallam; but the end was near, and after some months of acute suffering, he died at his home at Hawarden. He was buried in Westminster Abbey. Beside him, two years later, his wife was laid to rest. He was also survived by a family of three sons and three daughters. Herbert John, his younger son, is the first Viscount Gladstone (q.v.).

Gladstone made considerable contributions to literature, and was deeply interested in a wide variety of subjects. He was specially absorbed in the literature that has gathered around Homer and Dante, and wrote much on these subjects, as well as on ecclesiastical and liturgical history. Among his works are 'The State in its Relations with the Church' (1838); 'A Manual of Prayers from the Liturgy' (1845); 'Two Letters on the State Persecutions of the Neapolitan Government' (1851); 'Studies on Homer and the Homeric Age' (3 vols., 1858); 'A Chapter of Autobiography' (1868); 'Juventus Mundi' (1869); 'The Vatican Decrees, bearing on Civil Allegiance' (1874); 'Vaticanism' (1875); 'Gleanings from Past Years' (8 vols., 1879–90); 'The Irish Question' (1886); 'A Translation of Horace' (1894); and 'The Psalter with a Concordance.'

For over 40 years Gladstone held a commanding place in the public life of his country. He was primarily a House of Commons man, and in that most critical of assemblies stepped at a bound into the front rank by an almost unequalled debating talent, skill in exposition and constructive genius. It was only in his later years that he took to the platform and swept the country in his «pilgrimages of passion.» His faults lay in diffuseness, in the elaboration of fine points, and in the drawing of too subtle distinctions; but he could on occasion speak with remarkable concentration. As a financier he carried on the traditions of Pitt and Peel. No man, intent on keeping a sharp eye on the outgoings in his own business concerns, could have maintained a more scrupulous exactitude than did Gladstone in the handling of the national accounts. The idealist and the practical man were strangely compounded in his make-up: «Oxford on the surface, Manchester below.» Viewed broadly, there is a singular unity in his career; from first to last he stood for peace and retrenchment, and steadily set his face against all profusion or extravagance. He had an intense dislike to the bullying of small and weak nations by strong and powerful ones, did not hold with those who say that there is one morality for individuals and another for the state, but sought to bring the golden rule into operation in the intercourse of nations. He was conservative in all his instincts, and one who was slow to unlearn his prejudices; but once the process of conviction and conversion was completed, there was no turning back. He was possessed of a dialectical strength which, as Mark Pattison said of him, could twist a bar of iron to its purpose. His missionary zeal had sometimes its ridiculous side, as when he called on the civilized world and Providence to be his supporters in the advocacy of contrary policies. He was accused by his opponents of truckling to majorities and the mob; but it should be borne in mind that he had not infrequently to create the public opinion on which he depended. He failed to carry Home Rule for Ireland; but his was the propelling force that made its final settlement inevitable. His personality and the influences that molded his career were summed up by Lord Salisbury when he said that Gladstone was «a great Christian.» With him the passion for righteousness was as a fire in his bones.

Consult the official 'Life' by Morley (3 vols., 1903); Paul, in the 'Dictionary of National Biography'; Lathbury, 'Religious Life of Gladstone' (1909); Gladstone's own 'Chapter of Autobiography' (1868), in which he explains his attitude on Irish disestablishment; and 'The History of an Idea' (1886), referring to Home Rule; Hamilton, 'Gladstone' (1898); Buxton, 'Gladstone as Chancellor of the Exchequer' (1901); and Morley's 'Recollections' (2 vols., 1917).

D. S. Douglas,
Editorial Staff of The Americana.

GLADSTONE, Mich., city of Delta County, on the Escanaba River, the Minneapolis, Saint Paul and Sault Sainte Marie Railway, 10 miles north of Escabana. It has a cooperage, machine shops, gun works and lumber mills. It has also a good trade in flour and coal. The city government rests in the hands of a mayor and council elected yearly. The waterworks and electric-lighting plant are owned by the municipality. Pop. 4,211.

GLAGOLITIC (glag-ō-lĭt'ĭk) **ALPHABET**, a Slavonic alphabet classed as ancient Bulgarian. There is a MS. of the 11th century written in this alphabet in the Vatican, containing extracts of the Gospels for each day in the year; there are extant also three other MSS. written in the same letters.

The origin of this alphabet is undiscoverable. It is older than the Cyrillac; it may be a modification of Greek cursive writing; perhaps it is connected with Armenian and Albanian alphabets. Its use is confined to the liturgical books of Dalmatian Slavs. Cyril, a monk of Constantinople, invented the Cyrillac alphabet, of which this has sometimes been considered a variant. Both of these differ from the current Russian alphabet.

GLAGOLITSA. See Glagolitic Alphabet.

GLAIR (Lat. *clarus*, clear, Fr. *clair*), the white of eggs prepared and used as a varnish for preserving paintings. For this purpose it is beaten to an even consistence, and commonly mixed with alcohol to make it work more freely, and with a little fine sugar to give it body and prevent it cracking, and then spread over the picture with a soft brush. Book-binders also use it for finishing the leathern backs of books.

GLAISHER, glā'shėr, **James,** English meteorologist: b. Lewisham, Kent, 7 April 1809; d. Croydon, Surrey, 7 Feb. 1903. In 1840 he became superintendent of the magnetical and meteorological department of the Royal Observatory, a post which he held for 34 years. Between 1862 and 1866 he made 28 balloon ascents for the purpose of studying the higher strata of the atmosphere, on one occasion reaching a height of over seven miles. He was the founder of the Royal Meteorological Society, and of the Aeronautical Society, wrote numerous papers on subjects relating to astronomy and meteorology and was the author of 'Travels in the Air' (1871).

GLAMORGANSHIRE, Wales, the southernmost county of the principality, bounded north by Brecon, east by Monmouth, west by Caermarthen and south and southwest by the Bristol Channel. It contains great coal beds and is the seat of great iron industries. Agriculture is also well developed and grain, cattle, hogs, horses, sheep, etc., are raised successfully. Cardiff, Merthyr-Tydvil and Swansea are the largest towns. Pop. over 1,000,000.

GLANCE, English equivalent of the German *glanz,* a term applied to opaque minerals of which the high lustre and color indicate their metalliferous character. The following are some of them: *Antimonial copper-glance,* or wölchite, sulphide of antimony, copper and lead, with a little iron; *antimony-glance,* or stibnite, sulphide of antimony; *bismuth-glance,* or bismuthinite, sulphide of bismuth; *cobalt-glance,* or cobalite, sulph-arsenide of cobalt, sometimes with a little iron, also nickel and antimony; *copper glance,* sulphide of copper; *glance-blende,* or manganese blende, sulphide of manganese; *glance-coal,* anthracite; *iron-glance,* or specular iron, oxide of iron; *lead-glance,* sulphide of lead or galena; *nickel-glance,* amoibite or gersdorffite, arsenide and sulphide of nickel, with cobalt, iron, etc.; *silver-glance,* sulphide of silver; *yellow-gold-glance,* or sylvanite, telluride of gold and silver; *zinc-glance,* silicate of zinc. German miners use almost indifferently the term *glanz* and *kies,* the latter signifying pyrites, as iron pyrites, copper pyrites; but glance is not so frequently used among American and English miners, though copper-glance, antimony-glance, are sometimes employed by scientific men as well as in the mines.

GLAND, in anatomy, a term originally applied to such beanlike structures as occur all over the body in connection with the lymphatic system; but the meaning has now been extended to embrace any group of secretory cells. Such structures separate from the blood the characteristic constituents of their various secretions, and in most cases they are arranged in the form of small sacs, with contracted necks or ducts, through which the secretions are poured. Some glands, however, such as the thyroid and the suprarenals, are ductless, and their elaborated. products must be absorbed by the blood or by the lymph, for which reason they are sometimes called vascular. The liver is the largest glandular organ in the body, and weighs nearly four pounds. On the other hand, the peptic glands of the stomach are of microscopic dimensions, and consist of simple tubular recesses lined by a secreting cellular membrane, around which the blood circulates. The salivary, gastric and intestinal glands secrete the various fluids necessary for the digestion of food; while the kidneys and sweat glands are excretory, and pass waste products out of the circulation. Adenalgia and adenitis are terms applied to pathological conditions of the glands — pain and inflammation in them. The functions of the ductless or blood glands are imperfectly understood, but the thyroid secretion has a profound influence on the nutrition of the nervous system, the suprarenals determine certain blood conditions, while the spleen and lymphatics are largely concerned with the production of the cellular elements of the blood. Of late years extracts of various glandular tissues have been administered in cases of illness which appear to depend on defective gland secretion. The treatment has been a brilliant success in myxædema and in cretinism, which result from disease of the thyroid gland.

GLAND, *in plants,* a cell or group of cells of a glandular character in which is formed and secreted some substance. Plant glands are either superficial or internal. The secretion is generally formed by the protoplasm within the walls of the cell, but in some cases is produced at the surface. The glands are further distinguished according to the matter or substance secreted, as lime, water, resin and oil glands.

GLANDERS, the most dangerous form of equinia, and one of the most formidable diseases to which horses are subject. It is diagnosed by a discharge from one or both nostrils, with a hard enlargement of the submaxillary glands. It is distinguished into acute and chronic. In acute glanders the discharge from both nostrils is so great as ultimately to impede respiration and produce death from suffocation. Chronic glanders may run on for years before it terminates in the acute form of the disease. The discharge is usually confined to one nostril, is only occasional and sometimes trivial, with a moderate swelling of the gland on the affected side. The only other symptom of disease is a harshness of the coat. In the later stages the discharge becomes offensive. The disease is highly infectious, and acute glanders may be communicated to healthy horses and asses, while the animal first affected is still able to feed and work apparently as well as ever. It may even be communicated to man by the pustular matter coming in contact with any part where the skin is broken; and not a few deaths have happened through this cause. The disease is often difficult to determine, as the discharge is only offensive in the later stages. The symptoms may be mitigated by tonics and other treatment, but it is rarely if ever cured. The disease is now known to be produced by a species of bacillus (*mallei*) about the size of the tubercle-bacillus, discovered in 1882. Latent cases are diagnosed by means of mallein, the injection of which is accompanied by a rise in temperature and an extensive painful swelling at the seat of injection. See FARCY.

GLANDINA, glăn-dī'nạ, a genus of large spirally elongated snails (q.v.), which attain their maximum development in the southern United States and in Mexico. They include many species, all graceful in outline and beautifully colored. A rosy species (*Glandina truncata*) is common along the coast of Florida and westward, which varies greatly in size according to its circumstances, in favorable localities reaching a length of four inches. These mollusks are most commonly found among the marsh-grasses, where they hunt for and devour other snails by filing through their shells and rasping away the flesh by means of their lingual ribbons. Marine mollusks and other animals are also attacked.

GLANEUSES, Les, lă glă-nės′ («The Gleaners»), a painting by Jean François Millet, finished in 1857. It represents three peasant women who gather the forgotten stalks and ears in the wake of the harvesters. Its light effects are remarkable and it is considered one of the artist's greatest efforts. It is housed in the Louvre.

GLANVILL, Joseph, English ecclesiastic: b. Plymouth, 1636; d. Bath, November 1680. After studying at Exeter College, Oxford, he pursued theological studies at Lincoln College, being graduated M.A. in 1658. He held the post of chaplain at Eton, and after the Reformation became in turn rector of Wimbush, Essex, vicar of Frome Selwood, Somersetshire, rector of Streat and Walton. From there he was appointed to the Abbey Church at Bath, and in 1678 became prebendary of Worcester Cathedral. From 1672 until his death he was chaplain in ordinary to Charles II. His earliest work was 'The Vanity of Dogmatizing,' by which he is best known. It is the basis for Matthew Arnold's poem, 'The Scholar Gipsy.' Beginning with the Cartesian theory of cause and effect, Glanvill advances to the conclusion that there is only one great cause to which all others are merely secondary. Scientific reasoning, therefore, becomes the means for establishing the basis of faith. The «Popish Plot» brought forth a spirited defense of Protestantism under the title, 'The Zealous and Impartial Protestant' (1681). His other works include a revision of his first treatise 'Scepsis Scientifica: or Confest Ignorance the Way to Science' (1665); 'Philosophical Considerations concerning the existence of Sorcerers and Sorcery' (1666); 'Sadducismus Triumphatus' (1681); 'Plus Ultra; or the Progress and Advancement of Knowledge Since the Days of Aristotle' (1668), a noteworthy defense of the work of the Royal Society of London; 'The Ways of Happiness' (1670); 'An Earnest Invitation to the Lord's Supper' (1673); 'Essays on Several Important Subjects in Philosophy and Religion' (1676); 'An Essay Concerning Preaching' (1678) and 'Sermons.' Glanvill gave undue importance in his psychical research to rumors concerning quasi-supernatural events, but in general his studies show a profound appreciation of the scientific method. Consult Lecky, W. E. H., 'Rationalism in Europe' (1865).

GLANVILL, Ranulf de, chief justiciar of England, who flourished in the 12th century. He is known chiefly as the author of the first standard book on English common law. The facts of his life are few, but his career appears to have been somewhat as follows: He became sheriff of Yorkshire (1163–70); and in 1173 was appointed sheriff of Lancashire. He participated in the battle of Alnwick (1174) and in the following year was reappointed to his post at Yorkshire. The king then appointed him justice of the king's court and itinerant justice of the northern circuit, and in 1180 he was chosen chief justiciar of England. He rose to prominence and power during Henry's reign, but the king's successor, Richard I, threw him into prison. After ransoming himself at a handsome figure, Glanvill joined the Crusaders and perished at the siege of Acre in 1190. His work, which was written either by himself or under his supervision, was published under the title, 'Tractatus de legibus et consuetudinibus regni Angliæ.' It was the first important treatise on English law from the point of view of procedure, and is an invaluable source for information concerning ancient customs and laws, particularly of the *Curia Regis*. For many years, until superseded by the monumental works of Bracton, it remained the authority on all matters of legal procedure. It was reprinted many times and re-edited with annotations from time to time. The Scottish work, 'Regiam Majestatem' which follows it closely, is generally supposed to be a copy or an adaptation of Glanvill. Glanvill's treatise was first published in 1554. An English translation was not completed until 1812, when John Beames published his work with careful notes and introduction. An early French version is available in manuscript form. The latest edition is by J. H. Beale (Washington 1900).

GLARUS, glä′rŭs, Switzerland, a canton of the Confederation bounded north and east by Saint Gall, south by the Grisons and west by Uri and Schwyz. It has an area of 267 square miles and is composed of a valley enclosed on three sides by lofty mountains and open to the north. It is traversed by the Linth which flows into the Wallensee. It manufactures silk, woolen and cotton goods and beer. There is a large trade in textiles, but agriculture has not as yet been satisfactorily developed. The legislative power is vested in the people, who meet annually in the Landesgemeinde. The executive power rests in a council of seven, elected for three years by the Landesgemeinde. The people are nearly all German speaking Protestants. Glarus (q.v.) is the capital. Pop. 33,000.

GLARUS, Switzerland, capital of the canton of the same name, on the Linth. It contains a fine Gothic church, government buildings, a museum and an art gallery. It has cotton mills, cotton bleacheries, cigar works and distilleries. Pop. 5,000.

GLAS, John, founder of the Glassites, better known as the Sandemanians: b. Auchtermuchty, Fife, 1695; d. Perth, 2 Nov. 1773. He was educated at Saint Andrews and Edinburgh, took orders and became a preacher of note. In 1727 appeared his 'Testimony of the King of Martyrs,' in which he maintained that all religious establishments and all interference by the secular arm in ecclesiastical matters are contrary to the true nature of the Church. For advocating these views he was deposed from the ministry in 1730. He founded an independent congregation at Dundee and later removed to Perth, where he built a church. He was joined here by Sandeman, who became his son-in-law, and who became a prominent leader in the independent church movement in Scotland. His works were issued at Edinburgh in 1761 and at Perth in 1783. His 'Christian Songs' passed through its 13th edition at Perth in 1847.

GLASER, Otto C(harles), American zoologist: b. Wiesbaden, Germany, 1880. In 1900 he was graduated at the University of Johns Hopkins, and in 1904 received therefrom the degree of D.Ph. In 1901–02 he was assistant in the United States Bureau of Fisheries and in the North Carolina Geological Survey. In 1903 he was marine biologist of the Gulf biological station and from 1905 to 1907 was teacher of biology at Wood's Hole, Mass. Since then he has been connected with the University of Michigan, becoming in 1908 assistant professor of biology.

GLASGOW, Ellen Anderson Gholson, American novelist: b. Richmond, Va., 22 April 1874. She was educated privately and became prominent as an interpreter of the transition period in the Southern States after the close of the Civil War. Her works include 'The Descendant' (1897); 'Phases of an Inferior Planet' (1898); 'The Voice of the People' (1900); 'The Freeman and Other Poems' (1902); 'The Battleground' (1902); 'The Deliverance' (1904); 'The Wheel of Life' (1906); 'Ancient Law' (1908); 'Romance of a Plain Man' (1909); 'The Miller of Old Church' (1911); 'Virginia' (1913); 'Gabriella' (1916).

GLASGOW, Ky., city and county-seat of Barren County, on the Louisville and Nashville Railroad, 100 miles south of Louisville. It is the seat of Liberty Female College and is located in an oil-producing region. It has lumber mills, tobacco warehouses and factories, furniture and handle works and a large trade in lumber and livestock. Pop. 2,316.

GLASGOW, the chief commercial and manufacturing city in Scotland, and as regards population the second in the British Isles, is situated on both banks of the Clyde, about 14 miles from Dumbarton where the river broadens into a firth; latitude 35° 51′ 32″ N.; longiture 4° 17′ 54″ W. Distance northwest by north of London 348 miles as the crow flies, and by the various railway routes from 400 to 450 miles; west by south of Edinburgh, by road and rail, from about 42 to 50 miles; south of Inverness 206 miles by rail. The original city was wholly in Lanarkshire but was extended into Renfrewshire. By statute the whole municipal area as it existed in 1911 (12,796 acres) was in Lanarkshire. In 1912 extensions were made in Renfrewshire and Dumbartonshire, the total area of the municipality being now 19,183 acres. For certain administrative purposes that area forms by itself the County of the City of Glasgow.

Topography.— In prehistoric times, though subsequent to the appearance of man in the district, the lower part of the Clyde Valley, including a large portion of the site occupied by the modern city, formed the bottom of an estuary as is evidenced by the discovery of canoes as well as marine shells and other organisms in localities at a considerably higher level than the existing waterway. A very different condition of things existed when, in the 16th and 17th centuries, documentary evidence is procurable. Owing to shoals, produced by rock and other obstructions, no vessels other than small boats could then come within 12 miles of Glasgow. Deepening of the channel was commenced in the middle of the 18th century, and this and other improvements for facilitating navigation have since been prosecuted with such success that for a long time the largest trading vessels have had free access to the harbor at Broomielaw.

Glasgow streets are in general wide and straight. This is now the case even in the older portions of the city, the operations of the improvement trustees, under their act of 1866, having removed most of the buildings bordering on narrow thoroughfares and substituted spacious streets for the former overcrowded lanes. At first the citizens got building material, consisting of a light-colored freestone, within their own lands, and similar supplies were subsequently procured from quarries in the neighborhood; but a red sandstone brought from a distance is now being freely employed. Brick is seldom used in street frontage. Substantial masonry, combined with architectural beauty and amenity, generally prevails throughout the city.

Bridges.— The north and south sides of the river Clyde are connected by bridges and ferries at convenient intervals, and there is likewise a tunnel under the river Clyde for the accommodation both of pedestrians and vehicular traffic. The bridges are (1) the Caledonian Railway bridge, giving access to the Central Station; (2) Glasgow or Broomielaw bridge, 80 feet broad, in line with Jamaica street, rebuilt in 1899, the features and materials of Telford's earlier bridge of 1833–36 being retained; cost $500,000; (3) Portland street suspension bridge; (4) Victoria bridge, erected in 1851 to replace the old Glasgow bridge, supposed to date from the 14th century; (5) the Glasgow and South-Western Railway bridge leading into Saint Enoch's Station; (6) the Albert bridge built in 1871 of stone and iron, in line with Saltmarket and Crown street; cost $280,000; (7) Saint Andrew's suspension bridge and (8) Polmadie bridge, both communicating with Glasgow Green; (9) Rutherglen bridge, 60 feet wide, three granite arches, opened in 1896; cost about $367,500; and (10) Dalmarnock bridge. There are also several bridges over the river Kelvin and other streams within the city.

Parks.— Glasgow Green, superseding a smaller space known as the Old Green, though incorporating a portion of ancient burgh territory, was mainly formed on lands acquired in 1662 and subsequent years, but was not specially laid out as a public resort till the beginning of the 19th century. Since that time it has been chiefly used as a public park. Area 136 acres. One of the attractions is the People's Palace and Winter Garden, opened in 1898. The following are the other city parks, with the dates of acquisition and areas: Kelvingrove Park, intersected by the river Kelvin (1857–97) 85 acres; Queen's Park, embracing an old British camp and part of the site of the battle of Langside (1857–94) 146 acres; Alexandra Park (1871–91) 104 acres; Cathkin Park, gifted by

James Dick (1886) 49 acres; Ruchill Park (1892) 53 acres; Bellahouston Park (1895–1903) 185 acres; Tollcross Park (1897–1900) 83 acres; Richmond Park (1898) 44 acres; Springburn Park (1892–1900) 67 acres; Maxwell Park, gifted by Sir John Stirling Maxwell (1890) 21 acres; Rouken Glen Park, gifted by Mr. A. Cameron Corbett, M. P. (now Lord Rowallan) (1905) 220 acres; Botanic Gardens, with extensive ranges of hot-houses and green-houses (1891–1901) 43½ acres. Mr. Cameron Corbett also presented to the citizens in 1906 the mountainous estate of Ardkinglas in Argyllshire, containing upwards of 14,000 acres; Elder Park, Govan, gifted by Mrs. Elder (1885) and Victoria Park, Patrick (1889–1909) 65 acres, are now within the city boundaries.

Monuments, etc.— In George Square are statues of Queen Victoria, Prince Albert, James Watt, Lord Clyde, Robert Burns, Dr. Livingstone, Sir John Moore, Mr. Gladstone, and others, and in the centre a tall fluted Doric column surmounted by a statue of Sir Walter Scott. An equestrian statue of King William III stands near Glasgow Cross, a similar statue of the Duke of Wellington is placed in front of the Royal Exchange in Queen street, an obelisk to Nelson and the highly ornamental Doulton fountain are conspicuous in Glasgow Green, John Knox has a tall monument in the Necropolis, and a memorial pillar is erected on the site of the battle of Langside, where Queen Mary's chance of regaining the crown was finally lost.

Buildings.— The oldest as well as the most interesting and picturesque building is the cathedral, erected piecemeal in and between the 12th and 16th centuries, mainly in the early English style but marked by individuality. It contains nave, aisles, transepts, choir and crypt or lower church with chapter-house and Lady-chapel. Length of building 319 feet; breadth 63 feet; height of nave 90 feet and of choir 85 feet; height of central spire from floor of nave 217 feet. Two western towers were, under what is now regarded as a grievous error of judgment, removed in 1846 and 1848 respectively. In the vicinity of the cathedral were the residences or manses of the 32 canons, all of which buildings have now disappeared with the exception of the manse which was occupied by the prebendary of Provan. This pre-Reformation dwelling, the oldest in Glasgow, is still occupied. The cathedral belongs to and is maintained by the Crown, but the choir is used as one of the 10 city churches belonging to the municipal corporation, and the latter keep up the fittings connected with the religious services. Several of the other churches, belonging to different denominations, are of high architectural merit. Among other conspicuous buildings are those of the university, occupying about four acres of elevated ground, overlooking Kelvingrove Park. Consisting of an oblong rectangular pile, in the Collegiate Gothic style of the 14th century, and having a tower and open work spire about 300 feet high, the new premises were opened in 1870, replacing the old college which stood in High street on a site obtained shortly after the foundation of the original «Pedagogy» in 1451. At a short distance, on the opposite side of the river Kelvin, is the United Free Church College, built in the Italian style, with a high tower; and still nearer to the college, within the bounds of the park the new art galleries have been erected. Saint Andrew's Halls, for concerts and other public gatherings, were erected by private enterprise but were acquired in 1890 by the corporation who used the adjoining ground as the site of the new Mitchell Library which was opened in 1911. Besides the older city hall in Candleriggs street, the corporation possess other halls throughout the city for the accommodation of the respective districts. The city chambers, in the Italian Renaissance style of architecture, and occupying the whole of the east side of George square, with a central tower 216 feet high, were erected under the authority of an act of Parliament obtained in 1878 and were formally opened by Queen Victoria in 1888 though not occupied till the following year. Cost of site, buildings and furnishings about $2,756,000. Also abutting on George square are the general post office, the Bank of Scotland and the Merchant's House; and a few paces off, in George street, is the Glasgow and West of Scotland Technical College. Of other buildings throughout the city may be noted the Royal Exchange, in the Corinthian style, surrounded by a circular clock tower; the Stock Exchange, in the Byzantine style, the Athenæum buildings, the Deaf and Dumb Institution, the Christian Institute, the Royal Infirmary and the Western and Victoria infirmaries, the hotels connected with Saint Enoch's Station and Central Station and the hall belonging to the Faculty of Procurators.

Libraries.— The principal libraries are (1) the University Library (founded in the 15th century q.v. Glasgow University); (2) public libraries administered by the corporation, comprising the Mitchell Library (largest public reference library in Scotland) over 200,000 volumes, with 16 district libraries (for defraying cost of which Mr. Andrew Carnegie gave $500,000) each 8,000 to 17,000 volumes; (3) Stirling's Library (established 1792) 50,000 volumes; (4) Baillie's Institution Library; (5) United Free Church College Library; (6) Libraries of Faculty of Physicians and Surgeons, Faculty of Procurators, Glasgow Athenæum and Royal Philosophical Society. There are also numerous libraries in connection with scientific and other societies, churches, etc.

Art Galleries.— The corporation may be said to have begun its collection of works of art in 1670 when portraits of Kings Charles I and II were ordered from London. Portraits of other sovereigns were subsequently procured and were hung in the Council Hall; but it was not till about the year 1856, when the town council acquired the exhibition galleries and pictures which had belonged to Baillie Archibald M'Lellan, that the gallery and museum enterprise in Glasgow took definite shape. In consequence of many munificent donations and of judicious purchases, the collection became more and more valuable and rapidly increased, necessitating the finding of additional accommodation. This object was obtained when the new art galleries in Kelvingrove Park were occupied in 1902. Cost of construction $1,279,700. Branch art galleries have also been opened at the People's Palace on Glasgow Green (cost of construction, including Winter Garden, $83,375) and at Camphill in the Queen's Park. Glasgow is now famous as an art centre, and has given its name to the Glasgow School of Painting.

Churches.— Churches of the various denominations are well represented, those of the Presbyterian order preponderating, but there are numerous places of worship belonging to the Episcopal Church of Scotland, the Roman Catholic and other churches.

Educational Institutions.— The principal educational institutions are the university already referred to, Saint Mungo's College, the Glasgow and West of Scotland Technical College (including Anderson's College Medical School and Allan Glen's School); the Union Free College (for divinity students); Queen Margaret's College for women, connected with the university; the Glasgow Athenæum, the Glasgow School of Art, the Veterinary College, the West of Scotland Agricultural College, the Training Colleges for Teachers in connection with the Church of Scotland and the United Free Church, the Glasgow Academy and the Kelvinside Academy, the high school and others under the school board, with several educational establishments conducted by private enterprise.

Charitable Institutions.— Besides the three infirmaries already mentioned, Glasgow has an Eye Infirmary, the Royal Hospital for Sick Children, the Glasgow Samaritan Hospital for Women, the Glasgow Maternity Hospital, the Royal Asylum for the Blind, the Glasgow Institution for the Deaf and Dumb, the Glasgow Royal Asylum at Gartnavel, several minor hospitals and dispensaries, nursing institutions and convalescent homes.

Public Works.— The water supply of Glasgow was originally derived from the nearest streams and wells, and when these sources became insufficient water companies were formed for bringing in supplies by gravitation works and pipes. In 1855 the corporation acquired the works of these companies, at the same time obtaining statutory authority to bring water from Loch Katrine, 34½ miles north of Glasgow. Amount of capital expenditure on water supply to 31 May 1913, $22,513,340. Consumption per head (population of supply area 1,104,000) per day 41 gallons for domestic purposes and 24½ gallons for trade and public purposes. The gas supply, formerly in the hands of private companies, was taken over by the corporation in 1869. There are 1,048 miles of mains, and the number of consumers, 286,883. Street lighting and the lighting of common stairs, together with street cleaning, the fire brigade and all matters relating to public health, including the management of fever hospitals, are under the charge of the police department. In 1890 the corporation obtained statutory authority to supply electricity, and the necessary works having been put in operation, the streets are now lighted by that means, and the demand by the public both for lighting supply and motive power has been large and always on the increase. The total cost of the electricity works up to 31 May 1913 was about $13,923,042; there were 27,848 private consumers and 1,649 public lamps. In 1900 the corporation obtained from the Postmaster-General license to construct and work a telephone exchange over the Glasgow telephone area, covering about 1⅔ square miles. A telephone department was forthwith organized; but after being in operation for some years, the undertaking was transferred to the Postmaster-General in 1906. Markets, slaughter-houses and foreign animals' wharves are managed by the corporation, under a series of acts of Parliament, the earliest of which was passed in 1845. The corporation likewise administers the Weights and Measures Acts and manages several model lodging-houses, baths and wash-houses, an Inebriates' Reformatory (situated in Ayrshire) and a labor bureau. The navigation of the river Clyde was in the hands of the corporation, exclusively, till 1825, when it was vested in a body of trustees under a constitution which has since been altered from time to time. There are about 30 miles of main sewers, and the area drained is 41½ miles in extent. The scheme is, with the exception of that of the London county council, the largest in the world for the treatment and disposal of sewage.

Railways.— The principal railway systems are the Caledonian, North British and Glasgow and South Western, all of which have large modern termini in the heart of the city. There are underground railways, a cable subway, with a circular course passing twice under the river Clyde, and having convenient stations for various parts of the city. In 1894 street tramways, formerly worked by a company, were converted by the corporation into a municipal enterprise. In 1901 the whole system was changed from horse to overhead electric traction; existing length 196 miles of single track, and extensions proceeding, which will bring the total up to 238 miles; total capital expenditure to May 1913, $17,990,476; revenue to 31 May 1913, $4,907,265; passengers for a year, 311,480,086, at fares of a cent and upwards. The free surplus of $160,724 was paid over to the common good of the city.

Industry and Commerce.— Glasgow is one of the greatest industrial centres of the kingdom, and among its older industries are those connected with cotton, linen and wool, including spinning and weaving, bleaching, calico printing, lace making and Turkey-red dyeing. But of late years the progress of textile manufactures has been slow compared with the rapid development of the iron and steel industries. Mechanical engineering, marine engineering and ship-building, with their connected trades, are in extensive operation while chemical industries, the manufacture of glass and pottery and brick-making are also actively prosecuted. Some 300,000 tons of shipping are usually built in Glasgow yearly. The commerce of the city is commensurate in extent with the importance of its manufactures. Tonnage entered in 1913, exclusive of coasting trade, 2,251,784 tons; cleared, 3,628,912 tons. The principal articles sent from Glasgow to the United States in 1916 were sulphate of ammonia, $147,712; cotton manufactures, $3,226,187; whisky, $1,707,680; paper stock, $443,140; carpets, $257,762; hackled flax, $300,160. The rental of Glasgow in 1913–14 was $32,639,281. The combined local rates, imposed on owners and occupiers together, amount to about one-third of the rental.

Banks.—All the leading banks of Scotland are represented in Glasgow by numerous branches, and the Union Bank of Scotland and the Clydesdale Bank have their head offices here; as also have the Scottish Amicable, the City of Glasgow and other insurance companies.

Government.— Municipal affairs are administered by a town council whose statutory designation is "the corporation," consisting of 111 members elected by the voters in 37 wards (numbering *in cumulo* 230,228), with the Dean of Guild (elected by the Merchants' House) and the Deacon-convener of the Trades (elected by the Trades' House) as ex officio members. The lord provost and magistrates, a river bailie and deputy river bailie, a treasurer (honorary) and a master of works (honorary) are chosen by the councillors from their own number.

History.— The origin of Glasgow and its earliest community is beyond the reach of history. Joceline, the 12th century biographer of Kentigern, the patron saint of Glasgow, speaks of wandering through the streets and lanes of the city, and in the course of his narrative relates how its cemetery had been consecrated by Saint Ninian, the 5th century evangelist. More solid ground is touched in a legal document, which must have been compiled before the year 1124, setting forth the result of an inquiry made by King David, then Prince of Cumbria, into the possessions of the see of Glasgow, and from that time onward a fairly continuous outline of the city's history is obtainable. The bishops and archbishops possessed a large territory, called in later times the Regality of Glasgow, of which Glasgow was the judicial centre. In 1175–78 King William the Lion authorized the bishops to have at Glasgow a burgh, with a weekly market and all the privileges of a royal burgh. Twelve years afterward the same king granted right to the burgesses to hold a yearly fair in July, a privilege which still survives in Glasgow's annual holiday. The market cross of the new burgh occupied the spot where High street and Saltmarket intersect Trongate and Gallowgate. A chapel dedicated to the Virgin Mary adjoined the market cross, and half a mile farther west, a few paces from the present Saint Enoch's station, another chapel was dedicated to Saint Tenew, the mother of Saint Kentigern. Saint Enoch is merely a corruption of Saint Tenew which local pronunciation reduced to the form of Sanct-enew (or -enoch). Another chapel dedicated to Saint Thomas the Martyr was situated in the same locality. On the higher ground, adjoining the site chosen for the cathedral, a British fort or rath probably existed in ancient times, giving name to Rattounraw, one of the most ancient of the existing thoroughfares; and, if so, the rath may be identified with the large earthen mound called "the know of grummell," removed in 1599 to fill up hollows about the town. The rath, or what else served as a stronghold, was in or before the 13th century superseded by the Bishop's Castle, a structure which was not wholly removed till its site was required for the erection of the Royal Infirmary in 1792–94. The cathedral canons and Church dependents dwelt in the vicinity of the cathedral, while the industrial and trading community occupied the ground near the river, over which there was a primitive bridge at least as early as the year 1285. On the intervening space, somewhat precipitous, the Black Friars planted a convent and church in or before 1246. Between the years 1473 and 1479 the Greyfriars likewise settled in Glasgow, a little farther west, the site chosen by them being on the opposite side of the thoroughfare now called High street. A church or chapel in the Gallowgate, dedicated to Saint Kentigern, was founded in 1500; about the same time another chapel was dedicated to Saint Roche on a site which is commemorated in the place name now transformed into Saint Rollox; and the collegiate church of Saint Mary and Saint Ann was founded on the site of the present Tron church about the year 1525. Of the four pre-Reformation "hospitals" and their relative chapels, viz., the Hospital of Saint John of Polmadie, founded in or before the 13th century; the Leper Hospital, of an early but also uncertain date, Saint Nicholas Hospital, founded by Bishop Muirhead (1455–73), and Stablegreen Hospital, founded by Roland Blacader, subdean (1503–41), only some fragmentary endowments of Saint Nicholas Hospital survive, yielding small pensions to a few aged people. Glasgow was much pervaded by the ecclesiastical element, but this was to some extent advantageous as many of the Church dignitaries were in favor at court, taking a prominent part in state affairs, and exerting their influence for the good of the citizens. At first the Reformation changes produced disorganization and loss of trade. An attempt to arrest decay in the district deserted by the clergy, by the transfer of some of the markets to that locality, proved unsuccessful, on account of difficulty of access. The earlier charters of Glasgow were granted to the bishops who had the right to elect the provost and bailies. In 1611 King James VI granted a charter to the community direct, and subsequent charters kept to that form, but it was not till 1690, after the abolition of episcopacy, that the town council were allowed to elect their chief magistrates. Many of the inhabitants of Glasgow were opposed to the union, but the municipal authorities, both at that time and during the risings of 1715 and 1745, remained loyal to the government. Following the suppression of the latter rebellion, heritable jurisdictions were abolished and the regality courts were superseded by those of the sheriff, but the city retained its position as the judicial centre of the district. Shortly after this time the deepening operations on the river Clyde, to which reference has already been made, were commenced, and the city entered more fully upon that career of successful commercial prosperity which it has since continuously maintained.

Population.— The population of Glasgow has increased as follows: (1560) 4,500; (1600) 7,000; (1708) 12,766; (1763) 28,300; (1791) 66,578; (1803) 81,484; (1811) 100,749; (1841) 255,650; (1881) 511,415; (1891) 565,714; (1901) 761,709; (1911) 784,496. In 1912 the burghs of Govan, Patrick and Pollokshaws, and the districts of Cathcart, Scotstown, Shettleston and Tolcross were added to the city, which increased the population to 1,010,805. The population in 1914 was officially estimated at 1,032,228.

Bibliography.— Several histories of Glasgow have been published, those of John M'Ure, printed by James Duncan who introduced type-making to Glasgow, in 1718 (1736); John Gibson (1777); Andrew Brown (1795); James Denholm (1797); and Dr. James Cleland (1816), being the earliest. Original research is well represented in the publications of the Maitland Club and the Scottish Burgh Records Society, and the materials thus accumulated have been utilized in various works, such as Macgeorge's 'Old Glasgow' (1880); M'Gregor's 'History of Glasgow' (1881); Marwick's 'Historical Introduction to Glasgow Charters' (1897), and 'Early Glasgow' (1911): Primrose's 'Mediæval Glasgow' (1913). 'Municipal Glasgow,' edited by the town clerk, Sir John Lindsay, is well equipped with valuable statistical matter and contains an excellent historical introduction by the editor (1914, reprinted 1915).

D. S. DOUGLAS,
Editorial Staff of The Americana.

GLASGOW, The University of, a corporate body founded by a bull of Pope Nicholas V, dated 7 Jan. 1450–51, as a "*studium generale tam in theologia et in jure canonum et civili quam in artibus et in quacunque licita facultate,*" with the power of creating masters and doctors, who, together with the readers and students, were to enjoy the same privileges and immunities with the University of Bologna. A body of statutes was prepared, and the university established by the bishop and chapter in the same year. The university appears at first to have had neither property nor endowment. A purse was formed of the perquisites procured from matriculations, examinations, degrees, etc., and some of the earlier members bequeathed the patronage of a few small chaplaincies; but through the zeal of its founders and the civil and ecclesiastical immunities accorded to it, the new school of learning prospered, though in circumstances so little in accordance with modern notions of educational requirements. The clergy were induced to attend by offers of exemption from taxation and residence. The lectures in theology and in canon and civil law were read at the convent of the Dominicans; but the students of arts soon became so numerous that a house was provided for their residence called the pædagogium, and regular teachers were appointed.

In 1460 James, Lord Hamilton, bequeathed to Duncan Bunch, regent of the College of Arts, and his successors, a tenement in High street, with four acres of land adjoining, for the use of said college. On this ground the classes of the university continued to meet for 410 years. In 1577 James VI prescribed rules for the government of the university, and made a considerable addition to its funds. This new charter is called the Nova Erectio. It provided for a principal to teach theology and Holy Scriptures, who was also professor of Hebrew and Syriac; and three regents, of whom one taught Greek and rhetoric; another dialectics, morals and politics, with arithmetic and geometry; the third, physiology, geography, chronology and astrology. Between this period and the Restoration the university continued to flourish, and the number of its professors increased; but at the Restoration the re-establishment of the episcopacy deprived it of a great part of its revenues, and three of its chairs fell into abeyance. After the Revolution it continued gradually to expand the scope of its teaching, and has numbered among its professors and graduates many distinguished men. In the end of the 18th century it obtained by bequest the valuable anatomical museum, library and other collections of the famous Dr. William Hunter. Later the old buildings became quite inadequate and were sold. In 1870 new buildings at Gilmorehill, which cost over $2,000,000, were erected. In 1893 the buildings and grounds were extended by gift of North Park House and grounds for the use of women students, and Queen Margaret College, the women's department of the university, was founded. Through the munificence of the Marquis of Bute, Bute Hall was built for use in university functions. Considerable additions to the university buildings were made in 1907.

The University of Glasgow comprises five faculties, namely, arts, science, medicine, law and theology. The oldest chairs are those of moral philosophy (1577), natural philosophy (1577), logic and rhetoric (1577), Greek (1581), divinity (1630), Latin (previous to 1637), mathematics (revived 1601). In the first 20 years of the 18th century six professorships were either originally founded or revived, namely, humanity, Oriental languages, civil law, medicine, church history, anatomy; astronomy was added in 1760.

Eighteen professorships were founded in the 19th century, including the chairs of civil engineering and naval architecture. In 1903 the chair of zoology was founded and the chair of natural history became the chair of zoology. In 1911 the chairs of clinical surgery and clinical medicine, founded in 1874, were suppressed by the establishment of the Saint Mungo chair of surgery and the Muirhead chair of medicine, and in the same year the Muirhead chair of obstetrics and gynæcology were established. The most recent foundation is the chair of Scottish history and literature, established in 1913.

The university was reconstituted by the Scottish Universities Act of 1858, and a similar revolution was effected by the act of 1889. Under the latter act the Scottish Universities Committee of the Privy Council was constituted, and exercised powers until the end of 1897, when the founding of new chairs and the making of other ordinances according to a prescribed procedure, devolved upon the University Court, consisting of the rector (popularly elected for a three-year term by the students), the principal, the lord provost of Glasgow and certain assessors, with provision for representation by the affiliated colleges. This body also acts as a court of appeal from the senate, consisting of the principal and professors, which regulates teaching and discipline. The general court is composed of the chancellor, certain ex officio members and all graduates of the university. This body composes the voters' list, and in conjunction with that of Aberdeen University is jointly represented in the House of Commons by one member. In voting for their lord rector, the students are divided into four nations: Glottiana (Lanarkshire); Transforthiana (North of the Forth); Rothseiana (Bute, Renfrew and Ayrshire); Londoniana (all other localities). M. Poincaré, the President of France, was elected lord rector in 1915.

The students in 1914–15 numbered 1,835 males (a number that was appreciably diminished owing to withdrawals for military service) and 635 women — 2,470 in all. There are numerous foundations and bursaries in connection with the university, the most famous of which are the Snell exhibitions at Oxford University, established in 1677, tenable for five years, and of an annual value of $400. The library contains over 210,000 volumes. Consult Stewart, 'University of Glasgow' (1891); Coutts, 'History of the University of Glasgow' (1909).

GLASHAN, John Cadenhead, Canadian educator: b. Ellon, Aberdeen, Scotland, 1844. In 1853 he came to Canada with his parents and was educated at Toronto University. He was appointed teacher in the Provincial Model School, Toronto, in 1864, and later became inspector of schools in Middlesex County. In 1876 he became inspector of schools at Ottawa, in which post he remained until his retirement in 1910. He was made Fellow of the Royal Society of Canada in 1902. He wrote an arithmetic for schools, an advanced arithmetic, and, in collaboration with G. A. Wentworth and J. A. McLellan, 'Algebraic Analysis' (1889).

GLASS, Carter, American congressman: b. Lynchburg, Va., 4 Jan. 1858. He was educated in the public and private schools, learned the printing trade and served in the mechanical department of a printing office for eight years. He became owner of the *Daily News* (morning) and *Daily Advance* (afternoon), both papers of Lynchburg. From 1899 to 1903 he was a member of the Virginia Senate. He served on the State Constitutional Convention of 1901 and was a member of the 57th Congress for the unexpired term of P. J. Otey in 1902–03. He was re-elected to the 58th and succeeding Congresses (1903–19), from the sixth district of Virginia. In 1912 he piloted successfully through the House of Representatives the banking bill, known generally as the Owen-Glass bill (q.v.). On 4 Dec. 1918, Mr. Glass was nominated by the President to succeed W. G. McAdoo as Secretary of the Treasury. The nomination was confirmed by the Senate two days later.

GLASS, Montague (Marsden), American author: b. Manchester, England, 23 July 1877. In 1890 he came to the United States, was educated at the College of the City of New York and at New York University. He has followed literature as a profession since 1900; is a contributor to *Munsey's, McClure's, Metropolitan, Short Stories, Delineator, Harper's Weekly, Success, Smart Set, Saturday Evening Post* and other magazines, and is the author of 'Potash and Perlmutter' (1910); 'Abe and Mawruss' (1911), 'Elkin Tublimer —American' (1912); 'Object: Matrimony' (1912); 'Competitive Nephew' (1915).

GLASS. Definition and History.— Industrial art has had no more beautiful and useful material to aid its progress throughout the ages than glass, and many sciences could scarcely have existed, or could not have developed far, without its assistance. A perfect glass is surpassed in its brilliancy, pellucidity, refractiveness and colorless transparency only by the diamond itself. Its essential and distinguishing features are its freedom from air bubbles, specks of foreign matter and striæ. It can be produced either colorless or tinted with any hue, and either transparent or opaque. Its opacity may be either partial or complete. It is smooth and shining on surface and in fracture. It retains its shining surface upon being reheated, and is capable of a high degree of polish when cold. It can be welded by contact while in a semi-molten state, and fractured instantaneously — at a certain stage of manipulation — by chilling. It is tenacious and elastic, and can be blown as thin as gold leaf or spun as fine as the web of silk.

As the medium for one of the world's oldest handicrafts, much that is worth saying about glass cannot be said without reviewing the operations of its ancient artificers. The volcanic erupt, obsidian, an impure semi-transparent, vitreous substance, in color varying from a greenish gray to almost black, probably served as a native material from which articles for ornament and use were fashioned by the ancients before the event — accident or incident — occurred which gave the world its artificial substitute and complement, glass. This native glass — obsidian — invariably found in the neighborhood of some extinct volcano, was used by the Egyptians in the fabrication of works of art, and in some few known instances in articles of utility, but the artificial product, when once brought under control, effectually put a limit to its usefulness.

It is known that the Romans and the early Mexicans fashioned objects from obsidian, but in all probability the former used it as a variety of glass, and the latter from the fact that glass itself was unknown to them.

The period of the invention of glass cannot now be traced and how it was discovered is a matter of surmise, but of its importance there can be no question. What glass is, and what its possibilities are, no words could define more concisely than do those used by Dr. Johnson* in one of his papers to *The Rambler*. «Who,» he says, «when he first saw the sand and ashes by casual intenseness of heat melted into a metalline form, rugged with excrescences and clouded with impurities, would have imagined that in this shapeless lump lay concealed so many conveniences of life as would in time constitute a great part of the happiness of the world? Yet by some such fortuitous liquefaction was mankind taught to procure a body at once in a high degree solid and transparent, which might admit the light of the sun and exclude the violence of the wind, which might extend the sight of the philosopher to new ranges of existence, and charm him at one time with the unbounded extent of the material creation, and at another with the endless subordination of animal life, and, what is yet of

*Though *most* writers upon glass have quoted this eulogy, I am not aware of *any* having added the fact that Dr. Johnson in his young days resided in the town of Stourbridge, Worcestershire, England, the principal seat of British glass manufacturing. With Stourbridge fire clay (for the making of glass-melting pots) at his feet, glasshouse furnaces blazing all around him, glass manufacturers, probably, for his associates, and surely their sons as his pupils (he was one of the masters of the Stourbridge grammar school), he would, in all probability, get his inspiration from local environment. J. A. S.

more importance, might supply the decay of nature and succor old age with subsidiary sight. Thus was the first artificer of glass employed, though without his own knowledge or expectation. He was facilitating and prolonging the enjoyment of light, enlarging the avenues of science, and conferring the highest and most lasting pleasures; he was enabling the student to contemplate nature, and the beauty to behold herself.»

The essential constituents of glass are silica and alkali, and in accepting the authority of the ancient historian that these elements were present in the «sandy beach under Mount Carmel» and the «cargo of natron conveyed by Phœnician merchants from Egypt to Syria» in an unrecorded B.C. period, the camping incident, and the cooking fire accident may be accepted as contributing to the «sand and ashes, by casual intenseness of heat» being «melted into a metalline form» and giving the world a material absolutely essential to its progress.

«Rugged with excrescences and clouded with impurities» is a perfect word picture of what the first glass must have been. When and where the «shapeless lump» was first observed, who were the first artificers employed in bringing it under control, and in what manner a knowledge of its discovery and usefulness was first made known to the world may never be determined with certainty, but there is evidence in historic record favoring a division of the honors, giving Egypt and the Egyptians — the world's earliest craftsmen — credit for its invention and initial development, and ceding to the Phœnician merchants — the most notable «traders» among the ancients — the distribution of the knowledge of its existence, of its merits and possibilities.

Glass-blowing was practised by the Egyptians more than 4,000 years ago, and while there are gaps in the records, we have proof of its continuance during the times of the native monarchs, under the Greeks and the Romans, and again in the 7th century A.D.

Phœnician claims to the invention of glass determine very early association with the art. During the three centuries on either side of the Christian era the Phœnician merchants did much toward the expansion of the industry. Glass found among the ruins of Mycenæ suggests association with the art among the Greeks about six centuries B.C.

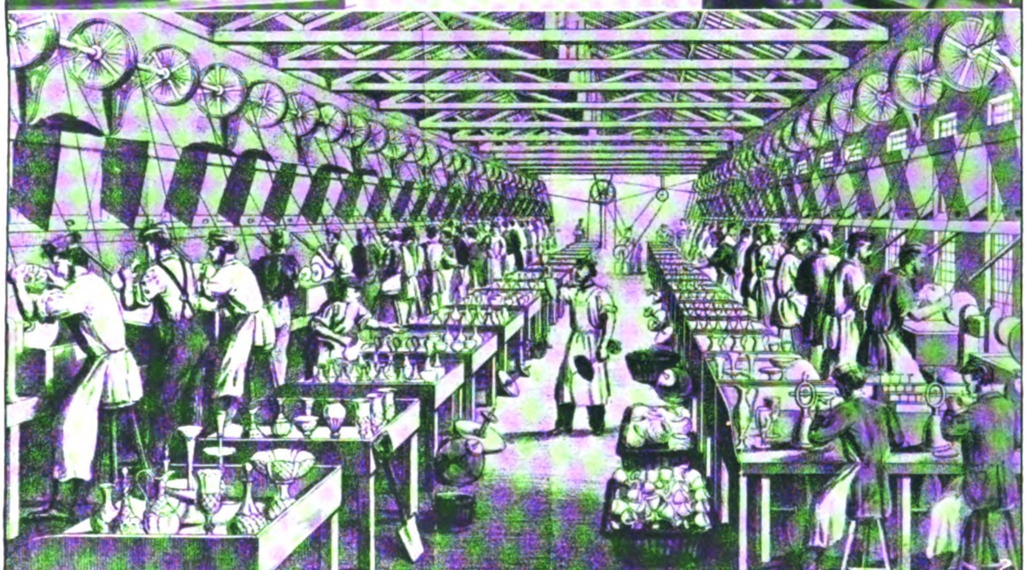
The Roman glass-making period covered several centuries. In early Christian times glass was made in several Eastern countries, and Pliny mentions Gaul among the Western countries practicing the art. Byzantium had its glass workers. The earliest date of which there is documentary evidence of glass-making at Venice is 1090, but once well established, the industry held a foremost place for about five centuries, declining considerably under competition from western Europe in the 18th century. Though Venetian glass production was limited in volume during the 18th century, some very important work was accomplished toward advancing the art in the higher grades, and the foundation was laid for the revival which occurred in the thirties of the following century, and has been maintained along the lines of some of its best features.

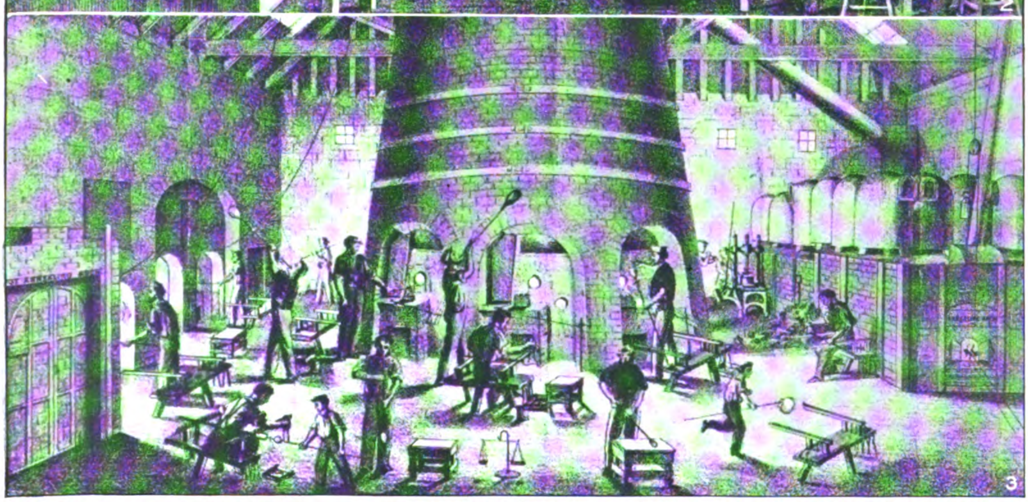
Western Europe advanced rapidly in the art of glass-making and decorating from the 16th century on; France, Spain, the Low Countries, Germany and the British Isles all contributing. Glass-making became an established industry in the United States early in the 17th century. Russia made considerable advance in the glass industry during the latter half of last century. Canada entered the field about half a century ago. India is now making glass for some of its own requirements; and there are indications that Japan is rapidly advancing in the manufacture of several varieties of glass production.

To a question as to the form in which glass has been longest in use, the answer would probably be, the bead. To follow the history of the bead the whole range of tradition and record of glass itself would have to be traversed. Beads of the native glass obsidian were in use in Egypt before the artificial substitute was discovered, and in every glass-making period since that discovery bead production has been continued. As glass itself resulted from the «fortuitous liquefaction» of two elements, so was the bead the fortuitous result of that liquefaction, and the initial action of the first molten glass was the automatic formation of a bead, without craftsmanship, without tool of any kind.

Beads were among the very first objects adopted as personal ornaments, and cherished as «charms,» and scarcely any important discovery of ancient glass has been made without beads formed some part of the find. Specimens made any time before 568 B.C. were discovered in the ruins of ancient Mycenæ. Fifth century history (B.C.) mentions «stony *molten* pendants» with which the ears of the sacred crocodiles of Egypt were adorned. Festoons of «bead-like gems» are mentioned in connection with glass of 300 B.C. The Phœnician and Roman glass-makers made beads extensively. Glass beads of Egyptian characteristics were unearthed in 1892 during excavations at Glastonbury, England, where activities commenced about 150 B.C. were ended prior to the period of the Roman conquest. (Consult Bulleid, A. and Gray, H. St.G., 'The Glastonbury Lake Village' (1911). Bead-making was practised at Venice in its earliest glass-making days, was an important branch of the industry there in the 16th century, and by the end of the 18th over 20 furnaces were employed in producing over 500 species. To come nearer home there are records of bead production in the very earliest days of American glass-making viz., 1621, when a new glass house was built to accommodate Italian workmen — presumably Venetians — in making beads, «to trade with the Indians.» Such a valuable discovery as glass could not, in the hands of a clever race of craftsmen like the Egyptians, be long limited in its use to bead or pendant production. but the suggestion for bringing the material under control and making possible its development would come from the material itself. Insufficiently fused glass always contains air-bubbles, and if taken from the melting pot in this condition and allowed to stream from the gathering instrument, the glass will continue to extend its length till it is chilled to hardness, the air bubble will remain a cavity, the end of the shaft or tube formed will be in bead or pendant form, and the hollow section of the shaft will be in form for division into lengths. Thus did the first glass bead get its perforation, and thus was suggested the blowing pipe, the

GLASS





1 Glass making at Franco-British Exhibition, London, 1908 2 Glass cutting and engraving, early 19th century
3 Flint glass works, early 19th century

essential for controlled expansion of molten glass. It is not outside the bounds of possibility that a form of decorating solid glass preceded the art of glass blowing. The presumed earliest form of ornamentation was by a process of uniting particles of the molten material with the surface of a previously partly fashioned form, and then by the aid of certain instruments and processes so distributing this applied material as to form a pattern or imitation of something else than glass, some natural growth or chalcedonic marking. Examples of beads so decorated are known and with an antiquity attributed to them more remote than that of the blown glass objects of similar characteristics there is ground for this argument. Glass workers of Egypt, Rome and Venice all produced ornamental effects by methods easily traceable to this primitive means of bringing molten glass under control. It possesses an advantage in being the most rapid of all the non-mechanical forms of patterning glass, the depositing movements being almost momentary.

Phœnician.— It has been argued that though the discovery of glass was made in Egypt, and by the Egyptians, the invention was put into practical form upon Phœnician ground, that Phœnician sand was used in its manufacture, and that its merchants were the first traders in the commodity, distributing it extensively over a large area in a day when transportation was not at all easy. Much of the glass made by the Phœnicians could scarcely be distinguished from that made in Egypt, but they had some characteristics peculiar to themselves. It is claimed that the colored glass bead originated there, was made most extensively and formed a considerable part of the merchandise with which they traded when traveling over Europe, India and other parts of the East, and into Africa. Discoveries in ancient tombs suggest they made many of the class of small vases associated with mortuary practices. Though small objects — many of them personal ornaments — appear to have been the principal part of the Phœnician production, they shared with Egypt a reputation for making large statues, obelisks and columns in green glass, possibly imitative of the emerald. In some classes of production the Phœnicians reached the greatest perfection, and possibly owing to their trading facilities the output of their workshops was larger than any others of their period.

China and India.— The earliest period of glass-making by the Chinese has been put at about two centuries B.C. Whether they discovered their own processes or developed the inventions of earlier craftsmen is not known, but it was not at all unlikely that the making of glass in the early Chinese form was associated with their efforts in the glazing of pottery, a science in which they excelled. Chinese forms and color effects in glass are suggestive of perhaps earlier work in carving objects from rock crystals, jade and precious stones; an art in which they were among the earliest experts. They made a species of glass known as *lieou-li*, capable of being worked into imitation pearls. Another kind of glass was named *po-li*. While some of the Chinese glass showed a distinct attempt to imitate natural stone forms and effects one of their early experts reversed the order and was accredited with being able, by means of fire, to change stones into crystal. There is no connected history regarding Chinese glass, but occasional record suggests a regular continuation of the industry. In the 7th and 12th centuries there is mention of its use in valuable objects for presentation purposes. The city of Djan-kou is mentioned as a glass-making centre in the 12th century. A 16th century writer eulogized a specimen of Chinese glass as "a fragment of that matter whereof the heavens consist." The work of the Chinese glass maker has been of great assistance to craftsmen in western Europe during the last century, and some of the most artistic glassware of modern times has resulted from the study of its features.

Ancient Indian glass bore a striking resemblance to that made by the Chinese of the same period.

Greece.— There is not much history to support the association of the Greeks with glass-making before our era, but mention is made of the use of "cups of glass," for drinking purposes in the 5th century B.C., and burning glasses were also known at that time. Glass for architectural decoration was known to have been used by the Greeks in a very early period.

About the time when the Barberini (Portland) vase — universally regarded as the finest example of ancient glass extant — came into the possession of the Portland family (1784), there arose a question as to whether this gem was of Greek or Roman origin. While it was known the Romans had very extensively produced this class of form — for sepulchral purposes — and excelled in the art of carving glass; that the urn was found in a Roman tomb, and was supposed to contain the ashes of a Roman emperor, there were certain characteristics which were decidedly more suggestive of Greek than Roman origin. Some of the critics not only maintained that it was of Greek origin but that it was the work of Phidias himself. Possibly this theory was suggested by the similarity between the low-relief carving upon the vase, and the bas-relief sculptures, by Phidias, upon the walls of the temple of Minerva at Athens. If it could be proved to be the work of Phidias (about 430 B.C.), or even of his time, it would be quite as much a tribute to the science of the chemist who compounded the materials, and the skill of the craftsman who fashioned the urn itself, as to the artist who sculptured the figures upon it; that particular form of ornamentation being then at its best in Greece, while the class of glass-making was not perfected till six centuries later at Rome.

Rome.—An authority upon ancient glass has made the assertion that during the period of the Roman Empire the manufacture of glass reached a point of development which in some respects has never been excelled nor even perhaps equalled. This statement was supported by an enumeration of some of the purposes to which the Roman glass was put, and the variety and extent of its production. Then, as now, the article for domestic use was the largest item of production, and this could be set down to the absence in those days of any suitable kind of glazed pottery for the same purposes. An enormous amount of glass was used for architectural decoration and also for personal ornaments. The wealth and luxury of Rome had a stimulating effect upon the production of the most costly works of art in several varieties of glass, and no other period has been so prolific in this sense. Pure crystalline glass was the most valued of any kind, and was more costly than the precious metals. Vessels for sacramental purposes, and urns as receptacles for the ashes of the dead, were extensively used throughout the whole period; the most precious examples of glass manufacture were those deposited in sepulchres; as many as 20 specimens have been found in a single tomb. The manufacture of artificial gems in glass was brought to great perfection. Roman glass of all kinds was exported verv extensively as has been proved by the abundance of examples and fragments discovered at widely distributed points away from Rome.

Notwithstanding the prodigious output in each of the several varieties, it is a remarkable fact that there were few large glass-making establishments, a great part of the production being provided by artificers working on a small scale. The period was also remarkable for the variety of colors employed in glass-making, for the numerous processes of manipulation and for the large number of decorative motives; and it is astonishing to what proficiency the glass worker had attained in all these matters. Among colors, blues and greens were most largely used, with many shades of each; then followed purple, amber, brown and rose color. These were transparent colors. In opaque colors, white, red, blue — in tones from lapis lazuli to turquoise,— yellow, green and orange. The yellows and greens were in various tones also. These were mainly self-colors but the range was extended by manipulating processes. A most interesting, and technically a very difficult, process in manipulation occurs in the making of the blank forms used in the glass we know as «cameo.» The Portland vase is the best-known example of this class. The Romans produced a vast quantity of it, though it is not quite certain that they originated either the methods of uniting the two bodies of glass required for the cameo effect, or the processes of sculpturing the ornamentation. Transparent blue was the usual ground color for cameo glass and opaque white almost invariably the coating from which the ornamentation was carved. Occasionally other colors were used. In this case the opaque white was inside the vessel, then a strata of clear glass and then the color or colors from which the ornament was fashioned. Pressed glass was one of the processes for certain forms of cameo. Discs, medallions and panels were produced in large quantities where replicas were required to complete a decorative scheme. It was not usual to duplicate vase forms in cameo ornamentation.

Black glass was largely used in making articles upon which food was served. It was also used — as was brown and other colors — in making imitations of onyx. The various uses to which glass of the «mosaic» class could be put were made the most of by the Roman workmen, though some of the motives were of Egyptian origin. The «mille fiori» class, imitations of porphyry, and serpentine, agates and granites, were used in architectural decorations, even to pavements and wall tiles. The manipulation of threads of colored glass into patternings of the «vitro di trina» order was a well-practised art.

A well-practised form of decorating glass by use of gold leaf was invented by the Romans. The gold was embedded in the substance of glass at first, but later a patterning was made of it on the surface. These patternings were occasionally embellished by a second application of molten colored glass enclosing the gold leaf. By one, or both, of these methods, pictorial effects were occasionally produced. Inscriptions in this ornamental form sometimes appeared. In the manufacture of personal ornaments in glass, a process and effect very nearly approaching the cloisonné of later times, was carried to a high state of perfection by the Roman craftsmen. An effect, very much of the appearance of the «deposit» silver of our own time was made at Rome, but by directly opposite processes. The design was pierced in the silver vessel and the colored glass blown into it. The same idea has been experimented with in quite recent times, but the annealing process developed difficulties.

Malleable glass was talked of at Rome. It evidently was considered a menace to the industry, as the invention and the inventor passed out tragically by the edict of a Cæsar. Glass toughened by annealing in oil is its modern equivalent.

Glass prisms were known; «when the sun shone through them they gave the colors of the rainbow.» Here we have the early form of the chandelier pendant. Magnifying glasses and lenses were also known.

The Romans preserved their choicest wines in amphoræ of glass. Window glass was used by the Romans at a time when mica, alabaster and certain kinds of shells were also capable mediums for transmitting light into the homes.

Though the Romans knew that highly polished black glass, or clear glass blackened on one side, would reflect images, it is not known for certain whether or not they made glass mirrors. The manufacture of Roman glass appears to have weakened as an industry after the fall of the empire, in all branches except mosaics. This class seems to have been continued, though with varying success, up to the 9th century.

Eastern Countries and Byzantine.— The art of glass-making seems to have been cultivated in ancient time in most of the Eastern countries, and though there is no way of linking the present with the past in this connection, there is little doubt the chain has not been broken for any lengthened period, and glass is made to-day in some of the countries that saw the blow-pipe operating in pre-Christian times. One writer says —«Glass furnaces flamed on the Syrian coast for 25 centuries.» Another —«The Sidonians carried the art of glass-making to great perfection»; and mention is made of «the celebrated Tyrian glass.» Glass was made at Antioch by the Jews; at Damascus; at Shiraz in Persia; at Smyrna. A large part of the ancient glass manufacture was in small objects, as vases, perfume bottles, personal ornaments and articles for sacred purposes. Articles of general utility were but a small part of the product. It may be, however, that such articles are unknown to us from the fact that they were not of sufficient interest or value to preserve. There were also some curious purposes to which glass was put. In the 12th century «a coffin of glass» is mentioned; also «a

1 Enamelled Goblet (Venetian or Franco-Syrian. About 1300 A. D.) 2 Saracenic Enamelled Glass (About 1300. Metal Mounting added in the 16th century) 3 Mosque Lamp from Cairo (14th century)

plate of glass used to keep dust from settling upon a painting." Byzantine glass has a long record, its two best periods being the 6th and the 10th centuries. It advanced considerably after the fall of the Roman Empire, probably on account of the aid obtained by securing the craftsmen who had worked at Rome. The great work of the Byzantine glass-makers for some time was in mosaics for church use. In the 10th and 11th centuries personal ornaments were a feature of production, in some of the methods earlier practised at Rome. They also used the Roman methods of pressing glass cameos. They were experts in the art of enameling and gilding of glass, but as the Byzantine decorative motives were employed at other eastern glass-making centres there has always been some difficulty in identifying their work. We know little of what they did in glass for domestic purposes. Byzantine glass-making passed out when Venetian came in.

Venice.— Glass-making has been a Venetian industry since the end of the 11th century. In mid-12th century Venice employed mosaic craftsmen. Half a century later other processes, those practised by Greek and Byzantine glass workers had been adopted there. Up to the last decade of the 13th century the art was practised within the city itself, but in 1291 it was decreed that the larger furnaces be demolished and the seat of the industry removed to nearby Murano. This law remained in force for nearly five centuries. About the beginning of the 14th century glass "lanterns" for galleys and lighthouses were made at Murano, also optical glass, in mass, for use by the makers of spectacles. Mosaic glass, beads, glass for windows and mirrors, vessels for ornament and domestic uses, were all separate branches, each conducted under its own code of laws, binding upon master and workman.

Manufacturing secrets were closely guarded, and the export of raw materials absolutely prohibited. "Crackled" glass, variegated or "marbled" glass, imitations of tortoiseshell and various chalcedonic effects were among the varieties then made. The glass known as *millefiori* came into use in the 15th century, and was long continued. The ancient Roman processes of manufacture had presumably been followed as there was a noticeable similarity in effect and appearance. The famous *vitro di trina* — also called *siligrana* — glass of Venice also corresponded in some of its features with the more ancient products known as "lace," "filigree" and "reticulated"; but the Venetian workman carried this class of glass-making to its highest point of perfection. This was undoubtedly the finest development of the art of manipulating threads of glass. Up to the middle of the 15th century the forms adopted by Venetian glass-workers were of the massive order and bore a resemblance to the silver work of western Europe. Colored glass — largely blues and greens — with decorations in enamel colors and gold tracery, with occasionally figure subjects, was produced at this time. Decorations in gold leaf, both worked into the substance and spread over the surface, were also well-practised forms of ornamentation. Later more classical outlines in form were adopted, and by the middle of the 16th century had reached a very high standard of elegance and beauty.

At this time special privileges were granted by the Venetian Republic to those who practised the art of glass-making and preserved it as a Venetian industry; but punishment, even to the death penalty, awaited those who carried its secrets to other countries.

The glass known as "avanturine" was a Venetian invention of the early part of the 17th century, and its manufacture remained a secret for at least two centuries. It has the appearance of myriads of atoms of burnished copper diffused through a mass of transparent amber. It was largely used by the Venetians in conjunction with other means of decorating glass. It has still many uses of an ornamental nature.

The full period of fame for Venetian glass can be reckoned in centuries, and with the possible exception of cameo glass, every variety of manufacture known to the industry seems to have been produced in some form, from beads and "burning glasses" to table wares and chandeliers. In the 17th century it reached its zenith, Venice supplied the world with its finest glass. The task, however, was a heavy one, and extensive distribution of the product, combined with other circumstances, forced western Europe — hitherto its best market — into the competition, which by the middle of the 18th century had wrested from Venice much of its best trade. It is to this period we may assign the foundation of what is now, and has been for at least a century and a half, the principal factor in the flint glass industry, viz., cut glass. As Venice declined, the new aspirants to precedence in glass manufacturing began their effort to advance "wheel-cutting" upon glass, as a substitute for the more fanciful materials which had served Venice so well in the centuries just passed. With "tablewares" as its staple, cut glass then began its revolutionizing influence. In the thirties of the 18th century one of the Murano manufacturers obtained permission to re-establish the glass-making industry in Venice itself, and with the additional protection of certain patent rights he succeeded in introducing a variety of production somewhat different to that hitherto practised. Among his successes were mirrors, with frames of glass ornamented by methods which have been practised in several glass-making countries since that time, and are even now quite familiar in some. Chandeliers ornamented with flowers and foliage — all made in glass — and a continuation of earlier Venetian motives all contributed to the success of his endeavor.

A century later, laudable efforts to revive the glories of Venetian glass were made along some lines of the old-time productions, and fortunately for the industry these efforts succeeded, and operations have since been uninterruptedly continued. Several of the earlier Venetian motives have been further developed, notably the form of decorating with "glass applied to glass" *at the furnace*. This feature remained long a Venetian characteristic, but in the eighties of the last century both French and English glassmakers adopted it, fruit and flowers — with their foliage — and grotesque animal and reptile creations supplying the motives.

France.— As Pliny mentions the "glass of Gaul" France may be credited with about 20 centuries of association with glass-making. Vessels and fragments attributed to the 2d and 3d centuries have been found in Normandy, and in the period between 486 and 752 glass-making was practised in several parts of the country. Greek workmen were employed there in the 7th century. There is 9th and 11th century evidence also. In the 13th, 14th and 15th centuries glass-makers worked at Poitou. Provence had its glasshouses as early as the 13th century, and they were quite important by the 16th. Window glass was made in Normandy in the early part of the 14th century. In the 15th century it was a custom in France for the proprietors of glass works to become practical in the art themselves, whether they worked at the furnace or not, hence the «gentilhommes verriers.» In 1556 glass-works were established in Lorraine, upon a site which has not even yet been abandoned. Presumably Venetian modes of production were adopted at the foundation, for as soon as history begins to record its progress we get evidence of operations identical with those which carried France along in its glass-making till it eventually — in the 18th century — dispossessed its mentors of a great part of their western trade. In 1664 the disturbing element of warfare arrested the progress of this establishment, but did not stamp it out, and when peaceable times came again preparations were made to restart the furnace fires. On 17 Feb. 1767 land was donated by royal decree to the promoters of the company, on condition that they erect a factory, homes for workmen and a church. Such success accrued from this incentive that after 20 years of effort to advance the art of glass-making the directors of the establishment were enabled to present to the Royal Academy of Sciences at Paris the first pure crystal glass ever made in France.

The government — delighted by this achievement — granted several thousand acres of forest land to the company — in those days wood fuel was used for melting glass — that all the world might know that it was the first in the French nation to fashion articles in pure crystal glass.

In 1788 three furnaces were in operation and more than 400 people employed in their working, an exceptionally large number in those days when small factories were the rule. In the 17th and 18th centuries there were works at La Rochelle and Nantes. Vessels for domestic purposes and for ornament were made; and enameling was one of the early forms of decorating, family and city «arms» and mottoes furnishing the motifs.

White and colored glass was made, including opalescent and marble effects. The secret also seems to have been known of patterning glass with studs formed in dies and welded on the vessel *at the furnace*. Much use has been made of this means of ornamentation in quite recent years. Mirror making was practised at Paris and at Cherbourg toward the end of the 17th century. These manufactories were united and the joint production was very large. About 1690 the process of casting glass was invented, and thus it became possible to produce very large plates. In 1693 these interests were transferred to Saint Gobain, a great centre of the plate-glass industry of our own time.

There is scarcely a variety of glass or a decorative motif that has not been practised by the French glass-worker, and in some branches they possess the largest establishments and employ the greatest number of people.

Belgium.— The period when glass-making was introduced into Belgium cannot be fixed for certain, but whenever it occurred it was under Venetian influence. Mirror-making and «glass of crystal in the Venetian manner» are mentioned in 16th century history. Toward the middle of the 17th century a «gentleman glass-maker» from Murano had a patent granted him to make glass at Brussels. The terms of this patent implied an intention to substitute for *imported* glass a real *home-made* article.

An example of glass, mounted in silver, in the peculiar «windmill» fashion of this period, is also mentioned. This same *verre au moulin* example had an engraved pattern upon it. Engraving upon glass became a well-practised art later in the century, and continued to be a feature of Belgian glass. Silver mounted glass has been such an important factor in the industry during the last 200 years that an early example is worth mention.

In 1825 an organization calling itself the Société des Manufactures de Glâces, with offices in Brussels — laid the foundation of a glass-making establishment from the operations of which the industry has since gained material benefit in many ways. The manufactories were located in the neighborhood of Liege — Val Saint Lambert and Jemeppe — now the principal seat of Belgian glass-making, but later were supplemented by establishments near Namur-Jambes and at Charleroi. Though most of the departments of the glass industry of a century ago were operated in connection with the original foundation, window glass was one of the earliest to be advanced to large proportions there, and claims were established to association with the great expansion which took place in the production of this commodity — and its accessories — in its many varieties. Among the early products were glass tiles, prism lights, vault lights, glass door signs and the many uses of plate glass. The different classes of glass production are now distributed over different centres and every demand is provided for; table glass, in crystal and colors; ornaments of many kinds; candle, oil, gas and electric lighting requisites; bottles and jars for the preservation of fruits and meats; coal-mine lamp chimneys; toughened glass, in vessel and slab form — and the blanks used in the manufacture of rich cut glass.

British Isles.— The period when glass-making was first introduced into Britain has been assigned to all the Christian centuries up to the seventh, each probability being supported by some historic note or tradition. Furnace remains and fragments suggestive of actual glass-making practices in the 4th century have been unearthed, and there are traditions of window glass-making in very early periods History tells us that in the 10th century «colored windows in churches were the work of high ecclesiastics.» There is no positive evidence however, in way of record, till mid-15th century times, when «glass windows were added to the homes.» Thomas Charnock tells us that glass-makers were «scant in the land» at that time. In the early days of the reign of Queen Elizabeth — 1558–1603 — an Italian was «making Venice glasses at ye Crotchet Friars in London,» and this may be taken as the starting point of British glass-making — other than window glass, which was in general use at that time — as an established industry. It may be presumed also that Venetian methods of production were employed, followers of those methods craving permission «to come to England, make glass and *teach the art.*» By 1589 there were 15 glass-making establishments in England. Progress in the industry was so rapid that in 1615 a law was passed prohibiting the importation of foreign glass; but five years later this law was made easier by an order to admit «rare and curious glasses,» probably for the sake of instruction in the art.

About 1620 glass-making was introduced into Scotland — again under Venetian supervision — and 12 years later into Ireland.

Mirror and spectacle plate glass was being made in England in 1634. Flint glass was introduced in England in the early part of the 17th century, and by 1673 was in general use; a London manufactory producing it «as clear, ponderous and thick as crystal.» The use of plate glass for many purposes, and flint glass for table wares and ornaments, became general about this time, and manufactories were established throughout England, Ireland and Scotland. Window glass, in its various forms of crown, sheet and plate filled demands not only of the building trades, but of the interior decorator, the cabinet-maker, the mirror-maker, the coach-builder and the ship-builder; and was linked up with the optical branches of glass manufacture, and in accessories for some sections of the flint glass industry. The advent of flint glass had a revolutionizing influence upon the whole trade and opened out many roads for its development and expansion. Table wares became its staple and «cutting» the most extensive form of decoration. The ancient arts of enameling, gilding and engraving upon glass were practised by themselves and in conjunction with «cut» designs; some of the patternings of that time requiring a second process when the limitations of the cutter's wheel had been reached.

The forms in use — for table wares — were very few in number, and all the establishments adopted the same shapes and decorations, being guided mainly by the home furnishings of their period. All through the Georgian times the same class of form obtained, and till well into the 19th century the only appreciable difference was in the elaboration of the several decorative motives.

Toward the middle of the century there was an all-round advance in range and form, variety of patterning and elaboration of treatment, the more highly skilled branches of craftsmanship being encouraged to meet the tastes and fashions of the time.

The dinner-table and sideboard needed additional articles and the mantel-shelf and cabinet called for more choice ornaments. Cut-glass furniture for the beautifying of the palaces of Eastern potentates was in demand; chairs, settees, tables, bedsteads and even balusters for the stairways had to be provided, as also elaborately constructed fountains and lamp stands. A pioneer example of this class is the glass fountain — made for the 1851 exhibition — still to be seen in the Crystal Palace, London. The 1851 (London) and succeeding international exhibitions very materially assisted the glass industry and many forms of production developed into large and continuous business from a single exhibition specimen. New departments of the industry about this time added largely to its wealth and importance. Hand and machine etching upon table-glass were introduced in the late fifties and early sixties, respectively; ornamental glass for table use and home decoration advanced enormously and brought with it extensive use for colored glass. Gas and coal-oil similarly benefited glass-making, without materially reducing the extent of candelabra and candlestick production.

Association with other industries — as the silversmith — also brought much benefit to the glass interests. Sculpturing of glass, after the manner of the bas-relief marbles of ancient Greece, was introduced in the sixties. The first specimen was in clear flint-glass and its decorative motif that of Greece in the 4th century B.C. Following this was the effort to revive an art not known to have been practised since Roman Empire times and believed to be of Athenian origin. This endeavor was to reproduce the «Portland Vase» in its original material — glass. The effort was successful in every sense and resulted in opening the road to several new features in glass ornamentation.

In the late seventies a decorative motif akin to glass sculpturing resulted from efforts to reproduce, in glass, some of the ancient examples of carved rock crystal. This effort too was entirely successful and resulted in the establishment of another new branch of the industry. In the early eighties, enameling and gilding upon flint-glass was successfully revived, as also was the *intaglio* style of cut-glass decoration, now sometimes called «stone-cut.» The process of iridising the surface of glass has been practised in England since 1880. In that year its application to very deep shades of blue and green glass produced effects very closely resembling the antiques of Egypt and Rome. The same material and process, used upon a surface «crackled» in the 16th century Venetian manner, produced «Scarahæus glass.» The manufacturing of flint-glass in Ireland declined about 1835.

JOHN A. SERVICE.

GLASS, Chemical Properties of. The surfaces of glass objects, though apparently stable under the conditions of commercial economic uses, are subject to certain chemical changes in favorable circumstances. All glasses containing alkalis, particularly if the proportion is unduly large, will give up a minute portion of that constituent to pure cold water standing against the surface for a prolonged period. If the water is heated the chemical action of solution progresses faster. This is quite noticeable in the case of cheap window glass used in greenhouses, which soon loses its polished surface on the under side, where it is continually moist and subjected to considerable heat. When the water touching the glass is very hot, as in a steam boiler under pressure, the action is quite rapid, as illustrated by the clouding of the glass gauge tubes of high pressure boilers. A piece of Bohemian (potash) glass placed in very hot water under high pressure will dissolve completely in a few hours.

Water containing alkalis exerts a chemical action on all forms of glass in which silica is a component, abstracting this substance by solution, and later carrying away the released alkalis and basic substances. On the other hand water containing a percentage of acid is very slow to attack silica glass, the acid seeming to reinforce the silica and oppose its separation. Strong acids, however, will decompose slowly glasses which have an excessive content of basic components, or in which there is a relatively large proportion of boric or phosphoric acids. Strong hydrofluoric acid and phosphoric acid are both destructive of glass surfaces, the former to such a marked degree that it is used to etch patterns upon polished glass. Deterioration of the surface also occurs where carbonic acid gas and moisture are both present in the air. The moisture which condenses on the glass begins the dissolving process, and the carbonic acid is absorbed by this alkaline solution, uniting with the alkali present to form a salt. In the case of a soda glass, a dry crust of crystalline soda carbonate spreads over the surface giving it a cloudy appearance. An attempt to wipe this off with a dry rag results in scratching the surface with the sharp soda crystals. It should be gently washed away with warm water, allowing plenty of time for the crystals to fully dissolve. In potash glasses the cloudy appearance is not seen because the potash carbonate is hygroscopic and remains continually in a liquid form. In both cases the alkaline skin or scum becomes a breeding place for certain bacteria or fungi which act destructively upon the glass. A percentage of boric acid in the glass mixture tends to prevent this bacterial action, and boric acid glasses are found to be notably resistant to atmospheric deterioration.

Glasses prepared for optical purposes are submitted to approximation tests as to their atmospheric resistance by placing them in a continuous current of moist air at a temperature of 175° F. for a period of several days. The durable glasses are unaffected. Those less durable exhibit varying degrees of dimming of the surface. This, however, is an arbitrary method, and it has not been proved that it really determines the relative economic endurance of the glasses tested.

Glass is also affected by prolonged exposure to direct sunlight. The action is most pronounced as to the ultra-violet rays, which produce a discoloration especially noticeable in glasses containing manganese: these glasses become brownish or purple-brownish. Similar phenomena of discoloration have been noted in glass subjected to the action of radium. The chemical sensitiveness of glass to the action of light is of considerable economic importance in the manufacture of photographic dry-plates. Glass which has once carried a strongly contrasted negative cannot be coated with emulsion a second time, for the image of the first exposure remains in some degree in the glass surface, and reappears in the second exposure.

The most resistant of all varieties of glass is a borosilicate glass containing some magnesia. After heating a few times, however, this glass has a tendency to become slightly milky and finally opaque. Its rival for many purposes is vitrified silica, which resembles glass in many respects, but, containing no alkali, is free from the deteriorations which the alkalis invite.

Chemical and Physical Properties, Colors, etc.— How long sand and soda served by themselves for the production of glass no one can now tell, yet while these elements are always the prime essentials scientific discoveries have from the earliest times so directed the artificer of this most useful commodity that no quality or variety of material and no color or shade of color is now impossible of production. There is scarcely a mineral that has not in some form been employed in glass-making, either for body or color. Sand, flints and various rocks have provided the silica, but sand is now almost universally used, as being more free from the impurities which affect glass — in substance or color — the most readily obtained and needing the least preparation. When rocks were used they were calcined, pulverized and freed as far as possible from impurities. There are different grades of glass-making sand. The first bed of the required quality mentioned in glass-making history was situated at the mouth of the river Belus, near Mount Carmel. The ancient Phœnician glass-makers used this sand, and the supplies were drawn upon extensively as late as the 16th century by the Venetian glass-makers for their finest productions; though for inferior kinds of glass they could use the sand of their own lagunes. The finer grades of glass require a purified sand and this is obtained by washing and burning out of the earths, metals and vegetable matter which affect glass in various ways if not removed before the melting process takes place. Iron is nearly always present and has a tendency to give a green cast to the glass. The proportion of sand in glass is rarely less than 50 per cent of the full mixture and not often more than 75 per cent. Outside these bounds the molten glass becomes difficult to manipulate. Where a more permanent glass is required an increased proportion of silica fused at a higher temperature will produce it, but at the sacrifice of other qualities. Various alkalis and alkaline earths are used to fuse the sand. Soda and potash are the chief solvents for nearly all the varieties of glass made. The ashes of wood, various plants and seaweed have also answered the purpose. In France, during the Middle Ages, the alkali used was produced from fern. There were alkali yielding plants in the lagunes of Venice. In the 15th century the dregs of wine provided Spain with a suitable ash for the purpose, and the early Chinese «made mirrors from pebbles and a material obtained from the sea and reduced to ashes.» A suitable soda can be extracted from sea-salt. Glass made from potash is more limpid than that made from a vegetable ash. The soil of Egypt, where the first glass is said to have been made, contained abundance of soda and sand. An excess of alkali makes glass liable to decompose through the effects of time and atmospheric influence.

Arsenic, alumina, barium, iron, lime, lead, magnesia, strontium, zinc are also elements in glass-making. The simple glasses are composed principally of silica and alkali; the mixtures varying according to requirements, and embrace the several kinds of window and bottle glasses. Ordinary window glass contains sand, soda and lime. Crown glass has potash added. Plate-glass contains sand, soda — or potash — lime, alumina and iron. Bottle glass has sand, soda, alumina and iron. The compound glasses are composed of silica and alkali, with more or less metallic substances. Flint glass is the most important of the compound varieties. Various recipes are employed in making it, but a well-proved one embraced in its composition sand, red lead, refined ash, saltpetre, arsenic, manganese and borax. These combined ingredients form the «batch» or «frit.» The proportions are roundly — three of sand, two of lead, one of ash and about one-fifth of one of saltpetre. The arsenic, manganese and borax are added in varying very small quantities, slightly graded in order named. Lead is the most important metallic substance in the compound glasses. It is used in the form of litharge and red oxide. Both are produced in the furnacing of pig lead. Both are active fluxes and glasses made with them require less alkali in proportion to silica than those made without them. The red lead, after it has been ground in water and dried to a very fine powder, is now the more generally used.

For optical glass and the strass from which artificial gems are made, an increased proportion of lead is required, density being the chief aim, though as with an excess of alkali its lasting power is affected. Density, refractiveness and pellucid brilliance are the qualities imparted to glass by the use of red lead. A refined ash ready for use is now obtainable. Saltpetre assists in driving off the globules of air in the liquid glass. Arsenic and borax are purifying aids. Manganese is used to neutralize the colors imparted by the other elements in glass. The aluminous earth frequently combined with manganese may be removed by a washing process. The aim is to make flint-glass absolutely colorless. It is considered «high» in tone when it assumes a pink cast; and «low» when of a green cast. The high tone may disappear during the working out of the metal from the melting pot, or it may be reduced by a very uncertain — and not to be commended — trick known to experts, but once low it remains low to the bottom of the pot.

Flint-glass is always liable to get low in color if kept in fusion too long. A «proof» is taken of the color of each pot of metal in the furnace as soon as the fusion is complete and the rough scum which always arises has been skimmed or raked from the top of the molten mass. The true color can only be correctly gauged by observing it through the thickness at fracture, lengthways of the proof, not through its surface.

The oxide of some particular metal is generally employed to produce particular colors in glass. Metallic substances so employed include antimony for ambers, purples, reds and yellows; copper for ambers, blues, greens and reds; cobalt for blues and greens; chromium for greens; gold for finest ruby reds; iron for ambers, blues, browns, greens, reds and yellows; nickel for blues and greens; silver for ambers and yellows; tin for reds; uranium for greens and yellows. Self-colors are usually made separately, but shades of all can be produced by superimposing one color glass upon another — or casing as it is familiarly called — and as many as six different colors in one article have been successfully united. A further variation in shade may be obtained by changing the quantities of the separate colors used. Ruby colored glass made from gold is essentially a «casing» material, not for use by itself, heat being an obstacle in the way of controlling the tint. Though the first melting of the «ruby» ingredients may show only a golden yellow tint — in which stage it is gathered into lumps and annealed — when reheated for casing purposes the desired ruby tint develops and continues to deepen in color by continuous heat. A vessel made from uncased ruby would be scarcely transparent, unless very thin. Gold is capable of producing a variety of tints in glass, including — besides ruby — shades of blue, orange, green and yellow. Copper is also capable of producing ruby tints, and a brownish red is obtained from iron. Sometimes ruby glass is semi-opaque, or what the glass-maker calls «muddy» and some peculiar freaks have occasionally developed from this cause. Some of the freaks in this connection — freaks because they cannot be controlled in the fabrication — show a muddy red exterior which changes to a dull but nearly transparent green when light is passed through it. Opaque and opalescent glasses are obtained from the use of oxide of tin, or from phosphate of lime, in the ingredients.

Fully opaque glass resembles porcelain, and while all the colors can be made opaque, chalk white, as a ground for other colors, is most frequently in use. Opaque white is used as an enamel, in the fashioning of glass vessels for painting upon, and, when united to another color, for cameo carving. When used for the last named purpose the usual «white» formula must be altered to agree with that of the glass with which it has to be united. Transparent and opaque glasses differ in density in the substance and the union of «hard» and «soft» glasses invites trouble after annealing; especially so when the abrasion of one of the parts is taking place — as in cameo carving — ruinous cracks often developing from the slightest initial fracture — as a scratch from any sharp-pointed instrument. Opalescent glass turns from clear to opaque by fire means, and can be controlled. The transition occurs during the process of fashioning the glass vessel, and the opacity can be arrested and largely controlled at the will of the artificer. When gathered from the melting pot the metal is transparent; a partial cooling influences the action of the opacity-producing chemicals in the ingredients and makes possible both transparent and opaque effects in the one article.

There are numerous recipes for coloring glass, but success with any largely depends upon the skill shown in adjusting the quantities of the several ingredients and in regulating the heat of the furnace during fusion; variations in temperature very materially affecting the shade of color. Various colors have been obtained from the same metal and various metals have produced similar colors. Amber tints can be obtained from antimony, arsenic, copper, iron, manganese, and silver. Black and browns from charcoal, iron, manganese and zaffre. Greens from copper, cobalt, chromium, iron, nickel and uranium. Purples from antimony and manganese. Reds from antimony, copper, gold, iron, and tin. Yellows from antimony charcoal, iron, manganese, silver, and uranium. Opaque white from antimony, arsenic, phosphate of lime; with sometimes a mixture prepared from tin and lead. The flint-glass «batch» is usually employed for colored glasses. The presence of iron, copper and other metals, in varying proportions, renders colored glass more subject to decomposition than uncolored glass. The iridization seen on ancient colored glass was not intentional in the fabrication, but due to chemical changes of the surface; long exposure and atmospheric influences causing a separation of the constituent parts and producing the minute flakes of glass which reflect the light at various angles and give out prismatic hues.

Similar prismatic effects can now be produced by the fumes of certain chemicals diffused over the surface of a glass vessel during the «blowing» process, and made permanent by reheating at the furnace immediately after the fuming has taken place. As with the ancient iridescent glass, dark grounds — especially greens and blues — throw out the prismatic colors best.

Whenever substances containing silica and alkali are subjected to intense heat, there is always the possibility of glass formation; as for instance, reeds or straw burnt in very large masses. Metallurgical operations, such as the smelting of ores, have produced glass. Glass-making history often refers to remelting glass. Lumps of glass sent from Spain to the Roman glass-workers were remelted when coloring materials had been added. Efforts to produce a superior glass for rich cutting have been successful when the whole first melting of the flint «batch» has been taken from the melting pot in an iron ladle and plunged into a cauldron of water, the effect being to break up the glass into small particles, in appearance like cracked ice. It was then refilled, corrected in color if necessary and remelted, producing a glass as nearly perfect as possible for cutting purposes and free from the striæ present at the first melting.

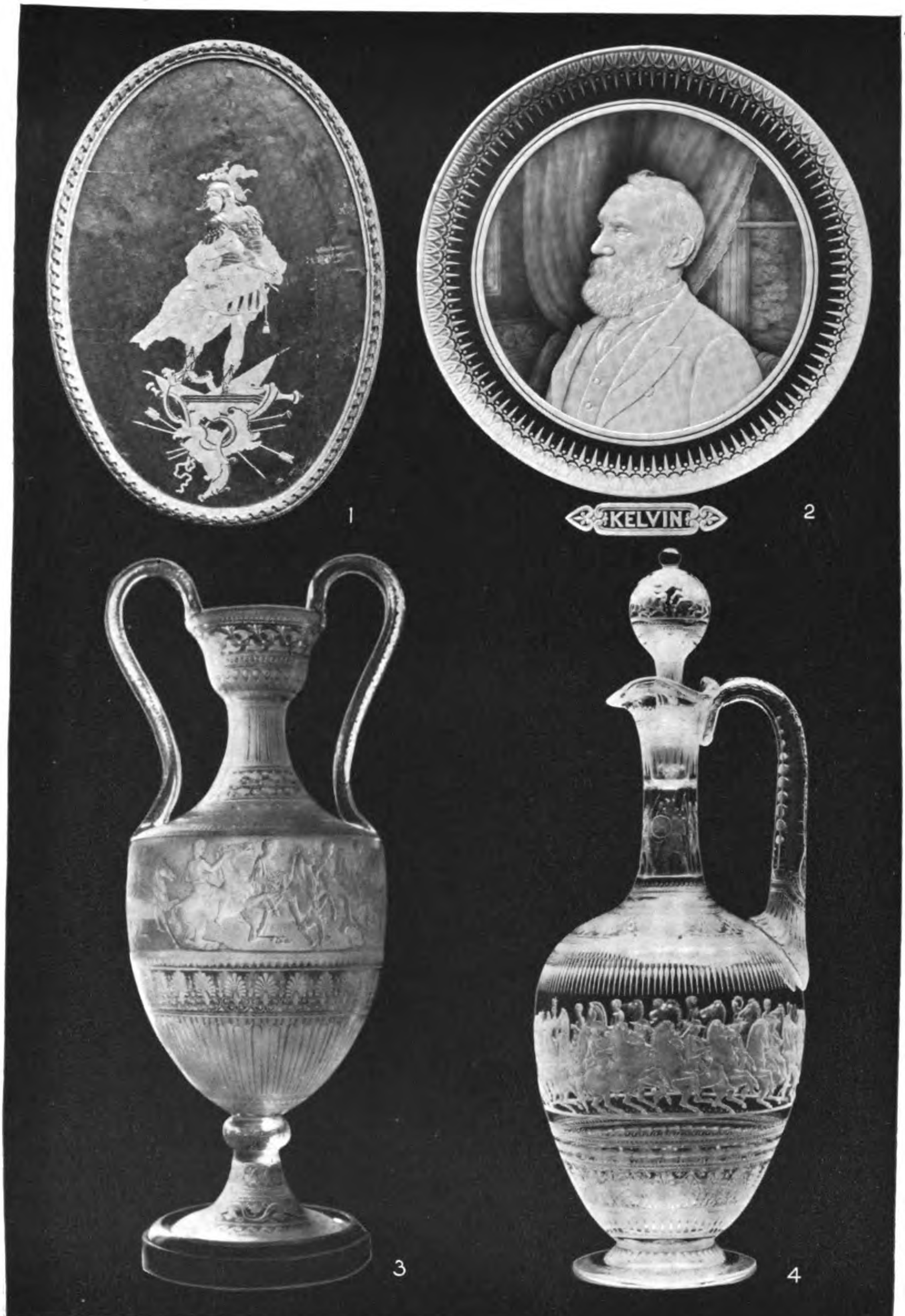
Glass at a high temperature is fluid and solidifies as the temperature is reduced. When regulated to a semi-fluid state it becomes tractable and its ductility admits of its being manipulated in a variety of ways; blown hollow through an iron blow-pipe, cast in a mold, pressed in a machine or with hand pincers, drawn out into lengths — either solid or hollow, rolled into plates, whirled into discs or sheared as cloth is cut with scissors. The peculiar tenacity of the substance enables any of these processes to be performed, but only by a practised hand, and as the metal rapidly cools, the several operations must be rapidly performed. The molten glass commences to harden immediately it is drawn from the pot in the furnace and quickly becomes incapable of expansion by air or manipulation by tool, but it can be softened to the working condition again by a plunge into any sufficiently heated enclosure, usually the mouth of the melting pot.

A moderate heat is required for the welding of glass, and handles or applied ornamentation can be made quite secure if the parts of union are without sulphur or smoke from the furnace, both of which elements prevent perfect cohesion of the parts. It is necessary to reheat quickly after the union is made. A cold metal coming in contact with a glass form upon the blowing iron when just cooled to hardness will initiate a fracture at the chilled part which will extend through the whole of its thickness when given a light blow, and separate the form from the iron — rod or tube — upon which it has been fashioned. These principles of welding and fracturing, both instantaneous in operation, are important factors possessed by no other material.

JOHN A. SERVICE.

GLASS, Cut or Incised. See GLASS, ORNAMENTATION OF; GLASS, VARIETIES OF.

GLASS, Ornamentation of. In the preface to one of his textbooks upon the application of art, Lewis F. Day says: «It is only in theory that ornament can be independently discussed. Practically it exists only relatively to its application.» «The necessity of adapting design to its position and use is as obvious as it is absolute.» These axioms are especially true in regard to the ornamentation of glass, as well from the nature of the material itself as from the variety in form to which ornament is at once a necessity and a complement. The earliest known manner and process employed in the ornamentation of glass was in all probability suggested by the «rugged excrescences» which disfigured the first «metalline form» described in Dr. Johnson's eulogy. By manipulating these excrescences and giving direction to the flowing metal, the first effort at ornamentation was accomplished. The same motive is carried out in every epoch of glass-making history from the earliest Egyptian times right into our own day. The principle is that of patterning or initiating a foundation for patterning by the manipulation of glass in its molten state, either by scoriation of the mass or by welding upon the surface of a partly fashioned form during the process of fabrication at the furnace. From the development of this primitive motive many of the most interesting and most beautiful decorative features known to the glass-making industry have been evolved. It is the base of the whole range of the reticulated classes of ornamentation which have characterized the efforts of glass-workers in many periods and in most countries. Antique examples in our museums show that ancient craftsmen in the East practised extensively this appliqué mode of ornamenting glass. The Greeks and Romans adapted it in various ways. It was a feature in Persian and Byzantine glass-making. Venice employed it in creations which have influenced ornamental glass production wherever the art has been cultivated during the last five centuries. Spain commenced its ornamental glass production along the same lines and the earliest known drinking vessels of glass used in Britain — supposedly of Roman origin — possessed the same constructive features. It needs no great stretch of the imagination to trace back such contributions to usefulness in glasswares as handles, stems and feet to this parent stock. The whole range of decorative motives resulting from the manipulation of lumps, strips and threads of glass welded upon the surface of a blown form, belong to this class. There are few records of the manipulating processes employed by the ancient glass-workers in turning these welded parts into ornament, but to one conversant with the material the difficulties are oftentimes not so great as they would appear to be. The ornamental treatment to follow the applique form is largely a matter of surmise, but the evidences are in favor of some form of cutting

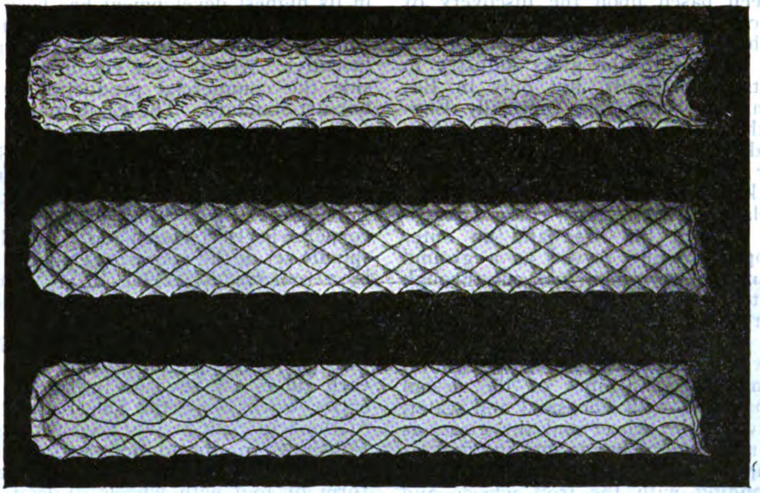


1 Antique Mirror
3 The "Elgin Vase"

2 Lord Kelvin by G. Woodall
4 "Elgin Marbles" Claret Jug

upon a wheel and the gem lapidist seems entitled to the credit of introducing it. Most of the early practised means of abrading glass ornamentally came within the term «cutting,» though they embraced grinding, scraping, rubbing and scratching.

Ancient examples of transparent glass in the British Museum show unmistakable signs of having been «cut» by means identical with those in use in our own time and it would appear to be unnecessary to look beyond them in an attempt to fix the origin of cut glass. Illustrations and descriptions of these examples appear in 'The History of Art in Chaldea and Assyria' by Georges Perrot and Charles Chipiez (Vol. II, pp. 306–307). Layard discovered them at Nineveh. The first named may have been used for some precious unguent. The description says: «It has been blown solid and then the inside cut out by means of an instrument which has left easily visible traces of its passage; this instrument was no doubt mounted on a lathe.»



Drawing A (top). Drawing B (center). Drawing C (bottom).

Without relying upon the «blown solid» argument the suggestion of a cutting instrument which left visible traces of its passage comes very near to the glass-cutting operations of subsequent times and incidentally is both an early suggestion of the principle of stoppering a glass vessel to preserve its precious contents and the advantages of transparent glass over other substances for such purposes of preservation.

The second example comes nearer still to cut glass as we know it. It is described as «a glass cylinder or tube of unknown use; it is covered with a decoration made of lozenges with a concave surface.» (See drawing A). The theory that it represents the beginning of glass-cutting gets some support from the class of cut distributed over its surface. In assuming its period to be about 700 B.C., it is not difficult to imagine the Assyrian lapidist who ground into shape the rock crystal lens discovered at same time and place (see Layard's 'Discoveries,' page 197), when about to make the always necessary test of his stone wheel—after «turning» it into shape—taking up the first glass object ready to his hand and by a chance abrasion discovering a means of ornamentation the very antipodes of the hitherto one and only «appliqué» method, i.e., cut glass.

The «cut» upon this antique is known as the «olive» and is formed upon a convex-faced wheel—such as may be used to «concave» a lens—the size of the wheel and the curve of the surface worked upon determining its outline. By encircling a tube form with a row of «olives» joined together, then repeating above and below in alternate spaces the first row of cuts automatically assume the «lozenge» form. The irregularity of the placing of the cuts is suggestive of the eventual lozenge pattern occurring from the accidental joining of a number of haphazard cuts, thus the entirely surrounded «olive» would become polygonal, while the partially free would have the «scale-like» appearance observable. Drawings B and C show these effects on tubes of same shape with «cuts» arranged in regular order. (For application of this motif see *The Art Journal* 'Report on International Exhibition,' London 1851, pp. 32, 175). Most facetted patternings upon cut glass are produced automatically from the crossing and recrossing of the lines of ornamentation. The remark «of unknown use» for this antique object has its significance. Possibly it had no definite use; the form being the usual experimental one of the glass-blower when testing the clearness of his «metal» and is the preliminary of many blown shapes, frequently never passing beyond this limit owing to various kinds of defect. The entire absence of any similar antique supports this theory.

The bas-relief ornamental glass (better known perhaps as cameo) of ancient Greece and Rome, was a form of «cutting,» the ornamentation being effected in part by the lapidary's wheel and it is probable the essential to finished cut glass—polishing—was in those times, as now, accomplished partly on the wheel.

The most famous examples of bas-relief ornamented glass known—the Portland vase—

has a highly polished surface and one of the arguments used to support a theory of Greek origin for this classic gem is based upon the known proficiency of the ancient Greek sculptor in the toreutic art.

Any incisory form of ornamenting glass — by diamond or hard metal point or by lapidary's wheel — was usually described by early historians as «cut,» but in the 13th century there are Constantinople records of «glass cups and shallow basins cut with the wheel.» That this was the true type of cutting may be inferred from the description given — «one cup has the surface so cut away that small cones are left standing up (the diamond cutting of to-day) and another has circles formed in same manner.» The writings of Chardin (mid-16th century) record Persian glass bottles «cut diamondwise.» There is a Bohemian claim to the invention of cut glass early in the 17th century, but as the art was not unknown in ancient Assyrian times and there are evidences of its practice in the early mediæval, this claim may have been based upon the discovery of some advanced production of the cutter's wheel; possibly the one which in later times proved such a boon to the glass industry in several of its departments, not only in Bohemia but in other countries, especially England about the middle of last century. This feature was developed from the substitution of «intaglio» for «relief» ornamentation upon cased glass of the kind formerly used so extensively by Roman glass-workers. Any colored transparent glass formed the base and an outer coating of opaque white served as a ground for the ornamentation which was cut through the casing into the substance beneath; the contrasting colors clearly defining the lines of the pattern.

Cut-glass patternings are produced by first grinding away the main lines of the design upon an iron wheel, with fine sand and water, streamed between the wheel and the glass, as the cutting medium. The second process is performed upon stone wheels, of shape and size corresponding with the iron wheels and kept wet by contact with a moistened sponge. This operation gives definite form and a smooth surface to the cut. The polishing is effected in various ways — by wheels of wood and cork; by wheel brushes and by an acid bath. The wheel polishing mediums are finely ground pumice and rotton-stone mixed with water, for first process; and afterward a putty-powder made from lead and tin, also mixed with water. The acid bath is hydrofluoric. The iron wheels rotate toward the operator, other wheels the reverse way.

As some of the descriptions of early «cut» glass most assuredly point to finely engraved intaglio ornamentation, with figure subjects a frequent motive, the glass-engraver's art must be accredited with quite ancient origin. An 8th century example is known but some of its ornamentation is so filmy that it may have been effected by a sharp pointed instrument instead of the metal wheel. In 15th century history engraving is mentioned in connection with German, Dutch, Venetian and French glass. By end of the century it had advanced considerably and the craftsman of that period was styled «lapidary and glass-cutter.»

For some considerable time after the 15th century the best work appears to have been done in Germany and Austria — the Bohemians being especially expert craftsmen — though the art was practised in several other European countries. The Spanish town of La Granja was famed for its engraved glass and as decorated mirror making was also a feature of production there the engraved mirrors (of the type shown in illustration) occasionally met with in southern Europe, may have originated there. Excellent engraving was done in France, Holland and England throughout the 18th and 19th centuries. Cut glass of the later Georgian periods produced in England, Ireland and Scotland received aid from association with the sister art of engraving and by this co-operation ornamental motives were carried to completion that could only have been partially effected by either one of the processes. The broad features of ornamentation were usually «cut»; the more intricate parts «engraved.»

Since about 1850, the art of glass engraving in its highest development has been extensively cultivated in the English [illegible]tories. The coming of the international ex[illegible]ion was the incentive. Artists were encouraged to step outside the commercial production and create a fine-art standard. The Elgin marbles claret jug (see illustration) was produced at Stourbridge for the Paris Exhibition of 1878, has been «round the world» for exhibition purposes and is now in a private collection in London. Engraving of this type is performed upon small copper wheels riveted upon the end of an iron spindle set in the mandril of a lathe and rotated by a foot treadle. The cutting medium is fine emery powder mixed with a thin oil. The engraving is done *under* the wheel and as the cutting medium obscures the actual contact of wheel and glass, the direction and duration of each cut is a matter of judgment. The glass-cutter works *over* the wheel and the progress of the «cut» can be observed through the glass. Polishing of the dulled surface left by the emery can be effected upon same lathe and form of tool with wheels of lead; with finely powdered pumice, mixed with water, as the brightening medium. The «lead-wheel» process of polishing engraved glass was the customary one until quite recent years. The subject on the engraved mirror illustrated shows its application. The parts shown black, upon the white ground, are the lead polished portions of the engraving. When adapting the engraver's art to the production of imitations of carved rock crystal — in the last seventies — lead polishing had to be abandoned as too slow a process. The rock crystal effects in glass gave a new lease of life to the engraver's art and opened new fields of operation for the most highly skilled of its craftsmen and its adoption as a new ornamental feature may be set down as the most important development, artistically, the table-glass industry has known in recent times. A true rock crystal effect in glass can only be obtained by complete restoration of the dull engraved ornamentation to brightness. At first, the polishing was done upon wheel brushes, but this was still too slow a process to meet the great demand which was eventually satisfied by the more rapid — and far more effective — acid bath process. The Elgin marbles sub-

TWENTY-FOUR-INCH PUNCH BOWL

This piece is called the "Lewis and Clark Masterpiece," as it was made especially for the Portland Exposition in 1905, and took first prize as the largest individual piece. Its value is $3,000

PUNCH SET FIVE FEET HIGH

This set can be easily taken apart and each piece used separately

In making fine cut ware such as this the best and purest materials obtainable are used, viz.: The purest American Sand; Oxide of Lead, from Spain, made by English manufacturers; Carbonate of Potash, from Germany; Nitrate of Potash, from Chili; Arsenic from Spain, and Manganese from Nova Scotia

ject had also served for the revival of the ancient art of ornamenting glass by *relief* carving. The «Elgin Vase» (illustrated) is in clear flint-glass and is the work of the late John Northwood of Wordsley, Staffordshire, England. (Photo by special permission of Sir Whitworth Wallis, director of Birmingham Art Gallery). It is the first modern specimen of bas-relief carving in glass. The aim of the artist was to revive this ancient art upon the lines of an ancient ornamental motif, by carving glass in a design of Grecian characteristics with an effect simulating the bas-reliefs perfected in marble by the Greek sculptor, Phidias, in his decoration of the walls of the temple of Minerva at Athens — commenced B.C. 448.

The accomplishment of this work was preliminary to John Northwood's more ambitious effort to reproduce in its original material — glass — that masterpiece of ancient art known from the time of its discovery (near Rome, end of 16th century) till the year 1786, as the «Barberini» and since that time as the «Portland Vase.» (British Museum).

This reproduction — the labor of years — with every feature of material, form, color and ornamentation in faithful facsimile, ranks among the noblest efforts of skilled craftsmanship in the glass-workers' art. The body of the vase is a deep transparent blue and the ornamentation was carved with steel tools from the «casing» of opaque white glass which originally covered the base and body of the vase up to a line between the junctures of the handles on either side. The long-lost secrets of sculptured glass having been fully revealed in this reproduction, the way was opened for 19th century craftsmen to emulate the deeds of ancient Greek and Roman experts in this art. The bas-relief form of ornamentation was almost exclusively adopted by the very limited circle of artists who practised it, a notable exception being the «Dennis Vase» in which free sculpture in all its purity is shown in the winged horse surmounting the cover and the forefronts of others forming the handles; all sculptured from shapeless masses of opaque white glass, welded to the form during its fabrication. This was also the work of John Northwood. Several decorative motives were adapted to this form of glass ornamentation, the brothers Thomas and George Woodall collaborating along these lines in the earlier period of the vogue which had been created for this highly skilful class of production. Subsequently decorative treatments became accessory only to the more advanced figure subjects in which George Woodall practically had the field to himself, no other aspirant to honors in this direction advancing beyond a second or third effort. While the decorative examples were varied in color, to suit the style of ornamentation, it was found that a rich, deep brown glass gave the best effect of light and shade in figure subjects, which were invariably sculptured from a casing of opaque white glass. Very slightly concave round placques also proved to be the most suitable shapes for figure subjects, although more difficult for the artist to work upon than a vase form. Placques up to 20 inches diameter have been used. George Woodall occasionally essayed portraiture, and permission has been granted to illustrate his most notable effort in this direction; his portrait of the late Lord Kelvin, sculptured from life.

JOHN A. SERVICE.

GLASS, Varieties of.— There are so many forms of glass in use in household and industrial economy that a survey of them is simplified by a classification into a few general groups.

Window glass, also known to glass makers as sheet glass, is commonly made in tank furnaces, the tanks being comparatively deep — from 20 inches to 3 feet. Deeper than this the mass of molten glass is found to suffer deterioration through incipient crystallization, known technically as «devitrification.» The type of furnace preferred is the high-crowned form, the melting of the glass being accomplished by radiation from the heated crown rather than by contact of the flame of combustion with the body of glass in the tank. The heights of such furnaces vary in different plants, being from two to five feet, with an occasional extreme of six feet, between glass and crown. The materials used are sand, ground lime or limestone, carbonate of soda or «salt-cake» (crude sulphate of soda), a percentage of oxide of manganese to improve the color and some fluxes. If the salt-cake is used as the source of soda a portion of carbon is required to reduce it, and this is supplied by anthracite coal. In this latter event it is common to use a reducing flame in the furnace, generated by admitting the air and gas separately to the furnace chamber. This method, however, is wasteful of fuel, and the preferable practice is to combine the air and gas in an outer chamber, in which their relative proportions may be accurately controlled. When the glass is melted to a proper condition the thick conical nose of an iron pipe between four and five feet long, having been previously heated to nearly the temperature of the molten glass, is thrust into the mass in the tank and turned over two or three times to accumulate a sizable lump of the viscid glass. Compressed air is then turned gently into the pipe and the bubble allowed to grow in the mass of glass, which is slowly withdrawn from the furnace and worked by swaying and turning until a longish cylindrical shape has been attained. The air is then shut off and the rounded bottom of the big bubble is heated to the melting point. The pressure of the air inside bursts open the bottom and rapid rotation of the blow-pipe distributes the glass into continuation with the plane of the sides of the cylinder. The glass form is then separated from the pipe by cracking it at the «neck» by applying a piece of cold iron. The cylinder, lying on a wooden rack, is allowed to cool somewhat. A thread of soft and very hot glass is then run around the cylinder just below the «shoulder» and when its heat has been imparted locally, the thread is pushed away and a cold iron laid upon the heated streak. A crack runs around the cylinder in the path of the thread, separating the cylinder. The sheet of glass has now a true cylindrical form. To open it out flat it is slit down the inside with a diamond, or is cracked by the application of a hot rod followed by a drop of cold water. The split cylinder is placed on a stone slab in a kiln in heat sufficient to soften the glass and then the rolled up sheet is pressed down flat on the stone with a special tool made of wood. The sheet is then annealed and after examination for defects is cut to the largest sizes possible, excluding the defects with the smallest amount of waste. Mouth-blowing is still practised in some of the smaller plants, but the success of the compressed air manipulation is crowding the old method out of use. The proposed processes of "drawing" glass sheets have been only recently successful. The process begins with a bubble blown upon a specially formed nose of a short blow-pipe. The lower end of the bubble is dipped into the centre of a pot of hot glass direct from the furnace, and the blow-pipe is attached to a reservoir of compressed air. The blow-pipe with its bubble is then hoisted vertically upward, the glass being drawn out in the form of a large cylinder, 21 inches in diameter and 20 to 25 feet long, air being blown in as needed to keep the bubble symmetrical. When the hoist is finished the glass cylinder is cut loose at the pot and then lowered, cut into five-foot lengths and split.

Crown Glass.— The term is applied to the method of its production, now practically abandoned. Almost any glass can be made by the crown method. A spherical bubble is blown and is opened by breaking off the tip at the blow-pipe, after an assistant has cemented the opposite "pole" of the bubble to an iron rod with a lump of hot glass. The opening is presented to the furnace opening and softened, the holding rod meanwhile being rotated. The former sphere assumes the shape of an open bowl and being more swiftly revolved flattens into a disc or "table" never more than 50 inches in diameter. This disc always has a boss of glass at its centre and generally some pronounced wavy corrugations surrounding it. These irregularities prevent the commercial use of the centre of the sheet, and the size of the square-cornered sheets which can be cut around it are necessarily small, while the proportion of waste is relatively very large.

Plate Glass is essentially cast-glass rolled into its mold. It is produced in two qualities, in one of which the materials are very carefully selected, as the product is to be ground and polished for plate-glass windows and mirrors. The other quality is used for skylights of buildings and shops and its principal qualification after transparency is cheapness. The defects that would be inadmissible in polished plate-glass are not noticeable in roofing-glass. Roofing plate-glass is of the same composition as sheet glass and like that is made in tank furnaces and in very large batches, up to 150 tons at a time. In casting a plate a long-handled ladle is introduced through the door of the furnace and dipped carefully into the molten mass, scooping up varying weights of glass, according to the size of the plate to be cast — up to 200 pounds. A sling attached to an overhead trolley lifts out the ladle and transports it to the cast-iron rolling table upon which the red-hot mass is thrown out. Guides of iron at the sides determine the thickness of the plate and a roller moving with them flattens it out. As soon as the sheet has cooled enough for handling, it goes to the annealing kiln, a long, tunnel-like chamber, very hot at the entrance end, and becoming gradually cooler toward the exit. Through this "continuous kiln," as it is called, the plate travels slowly, losing its heat by degrees. When sufficiently cool it is cut to size with a diamond. Various patterns of ribbed and figured glass are made by an adaptation of the roller method. The plastic glass is rolled out first into a plate between two hot rollers set at a fixed distance apart, according to the desired thickness of the finished plate. The rolled hot plate then passes immediately between another pair of rollers, one of which impresses the pattern upon it.

In the manufacture of polished plate-glass the materials are selected with greater care, and the glass is usually (though not always) melted in pots. The simplest practice is to lift these melting pots from the furnace bed by a crane and to pour the glass directly from them upon the rolling table. Some manufacturers pour from the melting pots into casting pots and reheat the glass in the latter before pouring. Where tanks are employed for melting, the special casting pot is always used. The rolling of the plate is carried out with great care to ensure as nearly as possible an even thickness. The annealing is done in a chamber with a perfectly level floor of loosely laid fire brick, which is sealed up for the cooling period of four or five days. The initial heat is sufficient to render the plate plastic, so that it settles down perfectly level on the floor. After cooling, the plates are cut to exclude apparent defects, and then ground down on a rotating table with abrasives of successive degrees of fineness. The grinding "rubbers" are blocks of heavy iron and they also are made to rotate with a motion contrary to that of the table. During this process the plate must be firmly supported over its entire surface to avoid being broken by the pressure, and this is accomplished by bedding it in plaster of Paris upon the iron bed of the grinding table. When one side has been ground down and smoothed to the point where it is fit to be polished, the table top with the attached plate is moved bodily to the polishing machine. The polishing rubbers are of iron faced with felt and are fed with rouge mixed to a thin paste with water. The highest polish is not secured until the glass has become distinctly hot from the friction. The surface then seems to become plastic and an actual rearrangement of its molecules to result. After polishing one side the glass is turned over and placed again in the grinding machine. Usually it is not bedded in plaster for this second grinding. The alternative is to lay it upon a wet, woolen blanket on the grinding table. Plate-glass is made in very large sizes, up to 25 feet in length and 12 to 14 feet in width.

Green or Bottle Glass.— The ordinary green bottle glass has, in addition to lime and soda, a proportion of alumina — up to 10 per cent — and may also have barium and magnesium in small percentages. The cheapest materials are used: natural alkaline rocks, along with blast furnace slag, basalt, etc. The green color is due to a considerable percentage of iron, which is of service in rendering the glass more easily fusible. Where the green is not very strong the color can be changed to amber by the addition of manganese. Bottle glass is made in the tank furnace the end farthest from the fire being provided with several working holes. Rings of fire-clay are floated on the surface of the molten glass to hold back the dross and the blowers take their lumps of glass on their blow-pipes from within these rings. By the old process, still in use in a number of the smaller plants, the bottle is blown with the breath. After the bubble becomes a certain size it is reheated at the furnace and then is placed inside of a mold of fire-clay and blown vigorously as the blow-pipe is turned round and round. It thus takes the shape of the mold, the neck part becoming quite cool and stiff. The mold is opened, and as the bottle is removed, an assistant pushes in the round bottom, with an iron rod or «pontil» having a bit of molten glass on its tip. This attaches the bottle to the pontil, and the neck part is cracked off from the blow-pipe. The assistant then presents the neck end of the bottle to the furnace and after softening it, places it in a machine in which the neck is formed and finished. The newer methods employ automatic machinery in which the bottle is blown in a metal mold by compressed air, and the output is increased many fold.

The making of large vessels of bottle glass is a somewhat similar proceeding. A thick sheet of the hot glass is laid upon a perforated iron plate, to which it is held firmly by clamps applied all around the edges. The combination is then turned over, and the plastic glass sags away from the centre of the iron plate. The sag is guided into a hollow mold, and then compressed air is turned on over the perforated plate, and the sag is enlarged and forced into close conformation with the mold. By this process such large glassware as tanks and bathtubs are successfully modeled.

Flint Glass.— The constituents of ordinary flint glass are silica, 53 per cent; potash, 14 per cent; and lead oxide, 33 per cent. Another grade, known as «dense flint glass,» is composed of silica, 38 per cent; potash, 8 per cent; and lead oxide, 54 per cent. Still another variety, called «borate flint glass,» is made up of borax, 66 per cent; soda, 4 per cent; alumina, 11 per cent; lead oxide, 7 per cent; and zinc oxide, 12 per cent.

Flint or crystal glass, as it is often called, is made exclusively in covered crucibles, for it must be protected from the chemical action of the furnace gases as well as from dust and bits of lime and silica dropping from the furnace dome. Flint glass is used chiefly for table and other hollow ware, and in the finer qualities for making lenses for optical purposes. It is valued in its ordinary uses for its brilliancy, imparted by the lead oxide. The same ingredient gives it greater weight in proportion to its bulk than that of the soda-lime glasses. The action of the lead is also notable in the clearing of the glass mixture, owing to the larger bubbles of oxygen it evolves. Arsenic and potassium nitrate are also employed in flint glass to aid in the clearing. Flint glass appears at its best when blown to the finish, without the intervention of a mold. It then has what is termed the «fire-polish.» It is extremely difficult, however, for the blower to keep so perfect a shape as to satisfy the demands of symmetry, and as a rule the final form is of the mold into which the glass is blown — as in bottle-making. To restore the brilliancy of surface it is customary to reheat the article at the furnace opening. This is an operation requiring great skill, as the heat must be sufficient to melt the surface, but not enough to cause a deformation of the model.

Pressed Glass.— Much time is saved, and a very satisfactory grade of ware is made by pressing the plastic glass directly into a mold instead of blowing it into approximate shape beforehand. The process requires heated molds, and comparatively soft glass. A plunger works down with great force into a cylindrical receptacle in which the hot glass is placed, and the molds connected with the cylinder are instantly filled. It is apparent that many articles can be made at the same time, with one stroke of the plunger, depending upon the number of molds connected. Pressed ware lacks the fire-polish of blown ware, but this is partially restored by reheating. Many optical lenses are made in this way, being pressed approximately to form and afterward ground to the required perfection of curvature.

Cut Glass.— Formerly the «blanks» on which the ornamental cutting was done were blown, and much foreign cut glass is still developed in that way, but the American practice is to press the «blanks» into molds, the glass used being dense flint. The blanks are first marked with chalk with the principal lines of the pattern. These are then «roughed out» on a grindstone, or with an iron wheel fed with sand and water. The blank is then chalked with the secondary lines of the pattern, and these are cut with an emery wheel. When all the angles have been trued up, the cut surfaces are polished on finishing wheels dressed with putty powder. A cheaper grade of cut glass is made by pressing the pattern into the glass, and then grinding the irregular faces true on the emery wheel, and polishing. The time saved is fully two-thirds, and as this item is the largest in the cost of making, the product can be sold at about half the former minimum. If the hot glass is properly worked in the press, there is no noticeable difference in the product.

Colored Glass.— Glasses which are intended to transmit colored light are prepared by adding certain chemicals to the mixture which otherwise would make colorless glass. Some colored glass is simply tinted white glass, as water may be tinted by adding a dye. In other cases the coloring is quite a different matter: the substance mixed with the glass has the property of stopping certain light rays, while not actually mingling with the glass. It has been suggested that this condition is one of suspension rather than solution, and that the color must be considered as due to the same interferences that obtain in the diffraction spectrum.

The color which any given substance will impart to glass depends in large degree upon the heat to which it is subjected. By different manipulation iron oxide may be used to produce red, orange or green, and intermediate shades. Chromium, added in the form of potassium bichromate, gives tints of green, and with the further addition of iron oxide or copper oxide yields bluish shades. Manganese, added as the black oxide, produces various shades of pink, lilac, violet and purple. If the temperature is raised to a higher degree the colors are yellows and browns. Copper, introduced either as the metal, or the oxide, yields reds, purples and black. These hues are altered by the addition of chromium in minute quantities. Repeated heatings will also change the original tint. Gold, added as metal, yields first amber, and by further heatings, red and violet. Uranium, added in the form of uranyl-acetate, or uranyl-nitrate yields yellow and green. Cobalt, added as the oxide, yields many shades of blue, depending upon the quantity used. Some of the colored glasses are so strongly tinted that in ordinary thicknesses they appear opaque and black. To make them thin enough so that the color shall be disclosed, would leave them too thin for any economic uses. They are therefore «flashed» upon white glass by dipping the lump of white glass as it is taken on the nose of the blowpipe into a basin of the colored glass and blowing the two together. Staining is a method of coloring glass by coating it with solutions of metallic salts, and afterward fixing the color by firing the article in a kiln. Glass may also be colored locally by fusing upon it a colored borax enamel.

Optical Glass requires in the first instance perfect homogeneity in order that such rays as pass through it shall not be deflected by inequalities in the glass substance. Especially is this qualification necessary in the glass that is to be used for making microscope and telescope lenses. The tendencies of different glasses to disperse the rays of light they transmit to varying degrees renders it needful to correct such peculiarities by building up the lens with several different kinds of glass. The centre of experiment in the manufacture of optical glasses was for some years at the great Jena Works in Germany, and here upwards of 70 distinct varieties of optical glass were made and offered to the lens makers of the world. These were nearly all varieties of crown and flint glasses, but ingredients were multiplied so that phosphoric and boric acid were substituted or added on the acid side of the mixtures, and baryta, magnesia and lithia were added to the available bases. Many of these experimental glasses have been discarded for various reasons, but a long list of wonderfully perfect glasses remain at the disposal of the optician and the instrument maker. Optical glass is usually allowed to get cold in the crucible in which it is melted. The glass chunk is then broken up into pieces, the faulty parts discarded, and the perfect glass remelted. It is then often pressed into approximate shape, and tempered for a long time before being ground into the desired form.

Wire-Glass, or wired plate glass, as it is often called, is made by the plate-glass process. It is dumped from the ladle in a mass upon a hot platform and a roller passes over it flattening out the sheet or plate. Closely following is a second roller which lays down upon the hot glass a length of wire netting approximately as hot as the glass. A third roller, bearing ribs, presses the wire into the plate of hot glass about half way through its thickness, and a fourth roller smooths down the plate and rolls it all into one. If the wired glass is to be used for roofing or skylights, no further finish is necessary. For some purposes, however, the glass plate is ground and polished.

GLASS BLOWING. There are three principal kinds of glass — window glass, plate glass and bottles and jars or hollow ware. Separate factories, or at least separate departments of factories, are devoted to each of these classifications. A glass furnace is fitted up for the kind of work it is designed to do. Previous to 1889, the furnace was almost always a great circular structure in the centre of a more or less circular building, with apertures on several sides, so that a number of men could work around it. The bottom of such a furnace is made of clay and is termed a pot. The fuel may be wood, coal, oil, natural gas, almost anything, but natural gas is the cheapest, and the glass industry thrives where gas is plentiful and cheap. In 1889 the continuous tank furnace was introduced, each tank having a capacity of about 15 large pot furnaces. In making window glass, which is also termed cylinder glass and sheet glass, a quantity of molten glass is taken up at the end of a long tube called a ponty. This the blower dips into the furnace, and by adroit manipulation brings out a sizable mass of semi-molten glass nearly white hot. Putting the other end of the ponty in his mouth, the glassblower uses all his lung power in rapid blowing, causing the glass at the other end to swell out very much as a child blows a soap bubble. He stands over a small pit, and blows and whirls and swings his ponty, with the hot glass bubble growing bigger and bigger, and by reciprocating it vigorously in the pit, the bubble elongates and soon assumes the form of a cylinder. When it is sufficiently large and has also sufficiently cooled, this cylinder of hot glass may be swung on to a flat table, slit longitudinally with a knife and will settle down in a flat sheet. It may later be annealed and cut into required sizes.

Hollow Ware.— Bottle glass, jars, tumblers and hollow ware generally are also made by blowing, taking the molten glass from the furnace on a ponty, but only a little glass is taken at a time, sufficient for one bottle or whatever is to be blown. After the blower has formed this into a hot bulb perhaps half the size of the finished bottle, he puts it into a mold, which he closes with his foot, and blows until the glass fills the mold, which determines its outer form. This is the hand method of blowing bottles. The machine method was evolved about 1896, and has gradually come into extended use, until now a large proportion of hollow ware is mechanically blown. Machine-blown bottles can usually be distinguished from hand-blown by the wide mouths which are essential to the process. The glass bottle-making machine has a combination of molds mounted on a rotary table. The molds may be individual or double, but each mold has an outer blow-section, with a ring in which the neck of the bottle is pressed, and a telescopic press-section rising within the blow-section and receiving the glass, forming, with the neck of the blow-section, a pressure-mold. The molten glass is dropped into the combined mold when in this pressmold position, and the table rotated to a point where the mold is under a plunger, which enters and presses the neck and wind-cavity into the dependent mass of hot glass. The plunger is then withdrawn, the telescopic section of the combined mold is dropped, and by another rotation the table brings the mold under a blow-stem, exposing the glass blank within the blow section. A bottom plate being inserted, air under pressure is admitted to expand the glass blank to the form of the mold. At the next rotation of the table the finished article is taken off by an attendant and sent to the annealing oven. Such is the system. In practice, the machines handle from four to eight bottles at a time, and can thus make many more bottles than a man, so that the production of a glass furnace is greatly increased. Only a limited number of blowers, as eight, can work around a pot furnace, as each has to be in a position to reach the molten glass. Therefore, when a machine doing four men's work is put in the place of each man, the output of the furnace is increased four times.

GLASS CRAB, an immature condition of certain crabs (*Palinurus* and its allies) which for a time are flattened and perfectly transparent, as if formed of a sheet of glass, and have no resemblance to the parent form.

GLASS-MAKING. As found ordinarily in commerce, glass consists of an alkaline silicate with one or more basic silicates melted together. From its molten state glass gradually stiffens as it cools, becoming solid eventually without having gone through a molecular change; that is to say, it has not crystallized. In this glass mixture silica takes the rôle of the principal acid, uniting with at least two basic oxides, one being of the alkaline metals. In many of the common forms of glass boron accompanies silica as the acid component. A general classification of the ordinary commercial varieties of glass would group together (1) those in which silica is the only acid component; (2) those in which only an alkaline base is combined with the silica; (3) those in which other acid components are present with the silica; (4) those in which no silica is present. The first group would contain the commonest of all glass — the soda-lime glass — as used for window glass, white druggists' bottles, table glass and hollow ware, etc. Its composition is silica, 72 per cent; soda, 13 per cent; lime 13 per cent; impurities 2 per cent. French window glass has slightly less silica, a trifle more soda, and a little larger percentage of lime. The second group would comprise what is known as soluble glass, or water glass. The third group includes most of the optical glasses, and the enamels and imitation gems used by jewelers. The fourth group is made up of the borate and phosphate glasses used in certain combinations in correcting the aberretions of lenses.

Raw Materials.— It is imperative that the materials put into the crucible for fusing into glass shall be scrupulously pure, as there is no way of separating impurities after the mass is once melted. The silica which constitutes from 52 to 72 per cent of the mass of the raw material before melting is obtained chiefly from a high grade of quartz sand. It is required to test at least 98 per cent pure silica. Of the impurities not more than one-half of 1 per cent of oxide of iron is permissable if the glass is to be used for fine table ware, cut glass, etc. If for optical glass, the proportion of iron oxide must not be more than 0.015 of 1 per cent. If for common window glass of a slightly greenish hue, the oxide of iron may run up to 2 per cent. Some of the «sand» used in making the finest glass is obtained by crushing quartz; and, as it is important that the sand be uniform in size of grain, it becomes necessary to screen the crushed quartz twice to get rid of the dust and fine stuff, and also of the particles which are too coarse. There are some soft sandstones which provide very good material but the extra cost of crushing and screening restricts their use to high-priced articles.

In the United States glass sands are found in commercial quantities in 18 States. In 1916 the amount produced was over 2,000,000 tons, chiefly from Pennsylvania and Illinois, somewhat less from West Virginia, and smaller, though substantial, quantities from New Jersey and Ohio. The finest quality comes from Berkshire County, Mass., and is practically pure silica; the Pennsylvania and West Virginia sands contain less than one-tenth of 1 per cent of iron. The New Jersey sand is higher in iron, but of good window-glass quality.

The principal source of soda is sodium carbonate, to be had in the market in a sufficiently high degree of purity. The cheaper sodium sulphate is used in making plate and window glass, but it is more trouble to use, as carbon must be added, usually as anthracite coal, and this is likely to carry other impurities. Sodium nitrate is employed to oxidize any organic matter present and to change the iron from the ferrous to the ferric state. In potash glasses the alkali is obtained from commercial pearl ashes or from salts of tartar.

Lime is provided from native limestone, if sufficiently pure. It must not contain more than 3 per cent of iron, when used for white glass. There is a large saving of heat in the glass furnace by burning the limestone beforehand, and grinding it just before using, although most of the burnt lime used is previously slacked. Natural minerals of the feldspar class are employed in common bottle glass, in which mixtures their iron content is desirable as a flux. Granite and basalt are other available sources of silica, soda and alumina, in glasses where all three may be used together. Magnesia is added to such glass mixtures as call for it, either as the carbonate or the oxide. The former is found sufficiently pure in nature, and has only to be calcined to produce the oxide. Barium is employed only in special glasses. It is added preferably as the carbonate, and in some barium glasses the natural mineral witherite is suitable after being ground to powder. For fine optical glasses the nitrate and the hydrate of barium are made use of. Manganese is widely used in the form of peroxide, occasionally as the sesquioxide, as a decolorizer in all white glasses. It always contains a percentage of iron and a little silica. In making opal glass, alumina is used in the form of hydrate, which is found in a very pure state in the markets. Zinc, as the oxide, is employed in heat-resisting glass. Lead is largely employed to impart brilliancy. In some plants litharge is used, but the form preferred is the red oxide. Boric acid and borax and arsenic are employed in some glasses. They are bought in the open market. In addition to the primary materials, a bulk of broken glass, known as «cullet» is always put in with a batch, sometimes more, sometimes less. As the cullet melts at a lower degree of heat it aids materially in breaking down the other raw materials.

Preliminary preparation is concentrated on the sand, which is washed again and again, then drained for several days, and finally dried — so that no moisture shall be carried into the furnace. Thorough mixture of the ingredients is of first importance. In some plants it is done by hand, but generally it is done mechanically, a large revolving drum with internal paddles being perhaps the most effective. The exact amount of each constituent used varies with the practice of each manufacturer, and, indeed, depends to a considerable extent upon the plant itself — the degree of heat generated by the furnace, the quality of the goods to be turned out, the methods of hand or machine production, etc. It is impossible to tell by testing any particular sample of glass just what ingredients were put into the furnace to produce it, for some of them are dissipated by the intense heat, and others remain in the slag.

Crucibles and Tanks.— The melting of the glass mixture is conducted either in crucibles or in shallow tanks. The crucibles are used for small batches, and the tanks for large batches. The crucibles, or «glass pots» as they are called, are of various sizes, to hold from 400 or 500 pounds up to two tons, or more. They are usually from 30 to 48 inches in diameter at the top, and somewhat smaller at the bottom, and their height is about equal to the diameter. They are generally round, but sometimes oval in outline. For the ordinary kinds of glass the pots are open at the top. For the finer kinds, which must be carefully protected from actual contact with the furnace flames, as well as from possible dropping of clay or other substance from the roof of the oven, the pots are covered over with a dome, and the opening is at the side, under a projecting hood with a little «hearth» below it. These pots are made of choice selected fire-clay, a part of which has been previously burnt. The clay is made into a stiff dough with a little water, and the pots are built up gradually, a segment at a time, the process occupying some weeks for large and heavy pots. When the pot is complete it is allowed to dry for several months. It is then placed in a kiln, and brought slowly to a bright red heat, which is maintained for at least 24 hours, when it is filled with glass mixture without being permitted to cool.

The tanks are simply basins, 20 inches to 3 feet in depth and often of great size, holding up to 200 tons of glass. They are constructed of large slabs of fire-clay material similar to that used for crucibles but somewhat coarser. These slabs are set dry, with no cementing material between. During the melting the liquid glass penetrates into the apertures between the slabs until it congeals from the lower temperature and thus renders the tank tight. The top edge of the tanks thus constructed is on a level with the floor of the furnace, and all parts not to be covered with the molten glass are made of silica brick.

Furnaces and Fuel.— Furnaces for melting glass have to be of the most highly refractory materials. Even fire clay will not stand the intense heat of the glass-furnace flame, and the dome or roof of the furnace, and also all of the walls not covered by the molten glass when in operation are constructed of bricks of almost pure silica, the 2 per cent allowable admixture being of lime and alumina. The side walls of the furnace are of large blocks of fire-clay, and it is the practice with some builders to put into the material a generous proportion of quartz pebbles. Two types of furnace are in use, one in which the fuel is burned directly in the furnace itself, the other in which an outer chamber is used to convert the fuel into gas which is then mixed with air and ignited, the flame surging through the furnace proper. In the former, the fuel is small coal or coke, and the heat passes upward through a short flue into the furnace chamber above it. The surge of heat strikes against the vaulted roof of the furnace and is thrown back upon and around the glass pots standing on the furnace floor. For a furnace of this kind several flues are usually provided in order to distribute the heat evenly. The burnt gases are taken out by numerous small openings around the sides so that there shall be no decided current of flame in any one direction. Very few of such furnaces are in operation, nearly all glass being now made in gas-fired furnaces, in which much higher temperatures are attained. Two types are in favor: the regenerative and the recuperative. In the former there are two regenerative chambers, one on each side of the furnace proper. These chambers are of fire-brick with cross walls of loosely piled fire-brick which, while they do not wholly obstruct the passage of the gases, delay them while the fire-bricks are absorbing their heat. The waste gases from the furnace are passed through one of these chambers on their way to the chimney, and when it has become very hot, these gases are turned through the other regenerative chamber, while the unburned fuel-gas is passed through the hot chamber, in turn absorbing the heat of the fire-brick walls. This reversal of the flow of the gases is alternated from time to time as the melting goes on, the course being changed about every half hour. The fuel-gas and the air required for combustion are thus heated very economically by the waste heat of the burnt gases.

The recuperative furnace utilizes the same principle in a different way. The fuel gas and air do not pass through the same chamber through which the waste gases have passed, but through adjoining flues which are heated by being surrounded by those gases on their way to the chimney. Each method has its warm adherents. It is to be said, however, that the recuperative furnace occupies less space, and does away with the necessity of reversing valves. It is claimed also that its heat is more constant, as the regenerating chambers are continually cooling off as the gas takes up the heat from the walls.

In both systems the hot gas and hot air are brought separately to the point where they enter the furnace, and are mixed at the very entrance. A rapid mixing causes a very hot but short and localized flame. A slow mixing produces a longer and farther reaching flame, and is better adapted to a larger furnace. In the regenerating furnace the direction of the flame is changed from one side to the other about every half hour, and this gives a more even distribution of heat. In the recuperating furnace the flame always passes in the same direction, and it is customary to cause it to return upon itself in the form of the letter U, and to make its exit from the furnace at a point close to its entrance.

In the tank furnace the openings for the entrance of the fuel-gas and air, and for the exit of the waste gases after combustion, are generally placed along the side walls of the furnace just above the level of the molten glass, or at the base of the dome of the roof. For tank furnaces the regenerative type is preferred, as the flame and exhaust are alternated at the several ports, and the heat is thus more evenly applied to the melting mass. The proportions of the ingredients used and the method of fusing and handling each special kind of glass are described in detail in the article entitled GLASS, VARIETIES OF.

Fusion.— The plant being prepared, the actual making of the glass is the successful intermelting of the ingredients. The more refractory of these are ground very fine; the sand is used in a granular form, freed from dust and coarse grains; the soda and salt-cake, which melt readily at a low temperature, are simply broken into small fragments. The weighing out of the several components is accurately done, according to the scheme of the individual glass-maker, each having his own particular variations from the standard formulas. Where hand mixing is employed, the mass is dumped into a bin and turned over again and again by shovelers, being finally passed through a sieve. The cullet is then added with more or less uniformity. If the glass is to be melted in a tank, it is merely shoveled in at the melting end, which supposedly contains melted glass — as the operation of the tank furnace is continuous. The mixture melts more quickly and with less expenditure of fuel in these conditions than in pots, where there is no melted glass to start with. In the crucible furnace practically all the previous contents of the pots have been emptied out, and the new material goes in dry. As there is much foaming during the melting, the pots cannot be filled at once, but as the melting proceeds more materials are added from time to time, from four to seven instalments, depending upon the size of the pot and the chemical reactions of the mixture involved. The last instalment is usually of cullet only. The frothing of the glass mixture during melting has the effect of filling the molten mass with innumerable bubbles, some of which are air, others carbonic acid or oxygen released in the chemical actions which take place. A high degree of fluidity is required to enable these bubbles to make their way to the surface of the glass. Some of them are got rid of by stirring with an iron rod, but this is liable to add iron oxide to the mass, and is highly objectionable in some cases.

To aid in this «clearing» process certain substances are added to the glass mixture to form large bubbles which shall gather up the tiny bubbles and carry them along to the top. Arsenic and sodium nitrate are often used for this purpose. The molten mass being clear, it is finally skimmed to remove the surface «skin» which contains many floating impurities. Before the glass can be worked it must be considerably reduced in temperature — that is, from the fluid stage to the plastic stage. In crucible furnaces this result can only be accomplished by cooling down the entire furnace. In the tank process the fluid glass usually is made to flow from the hotter melting end under a partition wall to the working end of the tank, which is kept at the lower, working temperature.

Annealing.— To avoid sudden fracture in glass, most careful attention is necessary in the annealing, or tempering. The operation must be commenced as soon as the fashioning of the form is completed. Glass expands with heat and contracts again upon cooling. Thick glass is more liable to sudden fracture than if blown thin and an uneven thickness is still more susceptible. Unequal contraction, due to the thicker parts retaining the heat longest, is the cause of fracture, and slow cooling to allow of gradual contraction the only safe remedy. Heated air is the most convenient and most generally used annealing medium, but hot water and heated sand have been successfully employed for the purpose. Occasionally all these mediums have been requisitioned in the perfect annealing of one article. A flint glass form judged to have been insufficiently annealed by the heated air means has been immersed in a bath of sand and water — of the same temperature as the glass — raised to the boiling point and kept there for a few hours, then very gradually cooled off. Glass shrinks very slightly upon cooling and the shrinkage is more perceptible after slow than quick cooling. Glass of uneven thickness, either blown thick and thin, or made thick in places by parts applied to the surface, will not contract uniformly and requires a slow annealing. Annealing in oil increases toughness in glass. There are different forms of annealing ovens to meet the requirements of quick or slow cooling periods. Heavily-made glass — especially that intended for cutting — needs very careful and long annealing and for this a kiln is generally used and is considered the safest. The whole lining of the kiln is of fire-brick. Fire boxes are built on either side of the one opening through which the glass is passed in and taken out. Several hours' firing is necessary to raise the temperature of the kiln to that of a little below the melting heat of the glass to be annealed. The glass should be of about the same temperature when it is first placed in the forepart of the kiln, between the two fire-boxes. As the floor space in the front becomes covered with the glass articles the individual pieces are taken up on the prongs of an iron fork, kept hot for the purpose and removed further back in the kiln and arranged so as to cover the whole floor space without the articles touching each other. When the kiln contains all it will safely hold — that is, without any of the articles being too near the fire-boxes — preparation is made to close up the kiln by means of iron doors which have inner linings of fireclay. The closing is gradual and depends upon the fire still in the boxes and the kind of articles in the forepart of the kiln. The interstices in the door are sealed with clay, so that no cold air can get into the kiln. When finally closed the doors are padlocked for safety. The closed period depends upon the class of goods within the kiln, but rarely less than four or more than six days is allowed.

The opening of the doors is as important as their closing, and, like the annealing, must be gradual. On removal the glass should be of the same temperature as the outside air to be quite safe.

Should any of the glass be insufficiently annealed — the sign of which is given by the heavier pieces cracking after being taken from the kiln — it may be replaced in the kiln before the next firing, with protecting screens of iron around it, and thus gradually heated and cooled again. The lear (or lehr) form of heated air annealing is for the lighter kinds of glass and such of the heavier forms which do not require so long a cooling period. Cooling in a lear may be effected in from six hours on, the period being determined and the glass placed in position, according to requirements, giving the heaviest pieces the hottest fire and the longest time.

The lear is in the form of a tunnel, with fire-boxes at the receiving end and a smoke chimney near the discharging end. It may be straight or circular and usually has a «quick» and a «slow» side, or both sides may be operated quick or slow at will. In a straight lear the glass articles are placed upon iron pans — square or oblong — and as each pan — which has a sprinkling of sand upon it — is filled to capacity with glass it has another one linked to it and by means of a windlass and chain is drawn away from its place contiguous to the fire-box and makes room for the next pan and so on continuously to the end of the week's work. After emptying at the cool end, the pans are returned to the fire end again for refilling.

As with the kiln, the lear temperature is first raised to about that of the glass it is to receive. At the end of the making operations for the week the iron doors of the lear are closed tightly and padlocked to prevent any casual opening likely to admit cold air before the cooling is completed.

A lear is arched over for about 15 to 20 feet but the bed is extended well beyond the arch and into the discharging room. A screen of cloth at the discharging end of the arch protects the lear from currents of cold air. The discharging (or sorting) room is constructed as nearly airtight as possible, the entrance to it having two pairs of doors, one pair of which must be securely closed before the other is opened. Cold air currents prevent perfect annealing and the glass upon the pans is liable to crack. An insufficient heat does not properly anneal and an excess of heat is liable to melt the forms out of shape so that much skill and care is required in regulating the temperature. The circular lear is considered an improvement upon the straight one but it takes up considerably more space. The annealing principles are the same but instead of a series of pans linked up one at a time and drawn away from the fire in a straight line, the circular plan provides two continuous tables — no intersections — flanged at the sides and moving free from each other, for slow and quick annealing, upon a tramway principle. Cogwheels underneath turned from a windlass rotate the separate tables past the fire-boxes as required.

The mouth of the lear and the kiln should be near to the furnace where the glass is made and the glass should be as hot as possible — so that it is below melting heat — when placed inside.

A precautionary measure is sometimes taken when the place in the furnace at which the glass is made is some distance from the annealing oven of keeping up the heat in transit by holding hot metal near the part of the glass most likely to be affected; usually where the iron pontil has been attached.

JOHN A. SERVICE.

GLASS MANUFACTURING IN AMERICA. A glass-house built near Jamestown in 1608, the year after Virginia was founded, was the first factory in the English colonies in America. In that year eight Poles and Germans were brought there to make ashes, soap, pitch, tar and glass. From ashes were obtained lye for making soap and potash for fluxing glass. Some glass shipped to England in 1608 or 1609 was among the first exports of the colony. Interfered with by the craze for raising tobacco, the manufacture of glass was suspended about 1615. In 1621 another glass-house was erected in which Italians made beads for trade with Indians. One or both glass-houses were destroyed in the massacre by Indians in 1622. The next glass works in Virginia of which there is a record were at Alexandria, where 10,000 pounds were manufactured in 1787. Works established at Wellsburg, Va. (now West Virginia), in 1815, were probably the works in Brooke County reported by census as making $20,000 worth of glass in 1820. At the tariff convention, held in New York city in 1831, two flint glass furnaces were reported in operation at Wellsburg and one at Wheeling; also two window glass works at Wheeling.

The first glass-house in Massachusetts was built in Salem about 1639. To encourage the enterprise the General Court in 1641 authorized the town to lend the proprietors £30. Glass was manufactured there for perhaps 20 years or longer. The General Court of Massachusetts in 1752 granted to Isaac C. Winslow and others the exclusive privilege of making glass in the colony and they probably built a glass-house at Boston which was in operation until shortly before the Revolution. The legislature, in 1787, granted to Messrs. Whalley, Hunnewell and others a charter, which conferred on them exclusively the right to manufacture glass in Massachusetts for 15 years, and fixed the penalty for infringement at $500. The capital stock was exempted from taxation and the workmen from military duty. Furthermore, the State paid a bounty on the product, to offset a bounty on glass exports paid by England. Under this charter, the manufacture of crown window glass was begun, in 1792, and about six years later the production amounted to $82,000 per annum. The glass, known throughout the United States as «Boston window glass,» was said to be superior to any imported. This State-aided enterprise, incorporated in 1809 as the Boston Crown Glass Company, is said to have been the first successful glass works in this country. Works established in 1802 at Middlesex, now a part of Lowell, made annually, about 1820, about 330,000 feet of window glass, which at $13 a 100-foot box amounted to $43,320. In 1812 a glass-house was built at South Boston and about the same time another at East Cambridge. The one at South Boston, the first flint glass works in Massachusetts, was built by Thomas Caines, a skilled batch mixer and glass blower, who had been employed by the Boston Crown Glass Company. After the War of 1812 the business failed. The works at East Cambridge were built by the Porcelain and Glass Manufacturing Company, which employed glass workers from Europe. Unsuccessful in business, the company leased the plant to a firm of workmen, Emmet, Fisher and Flowers. They failed to agree, and, in 1817, the business was sold at auction to the New England Glass Company, which was very successful. In 1823 the weekly production was 22,400 pounds of glass vessels, many of which were equal to the product of the best English flint houses, and some of which were beautifully cut. A plant established at Sandwich, Mass., in 1825, introduced, in 1827, the making of pressed glass. Until then all glass had been either blown or cast. The shaping of glass by molds made possible the production at low cost of many articles of the same pattern.

Glass was made in New York State under both the Dutch and English régimes, but plants established before 1850 were not permanent. A plant started at Brooklyn, in 1754, existed only a short time. In 1785 Leonard De Neufville and associates, proprietors of a plant at Dowesborough, 10 miles from Albany, applied to the legislature for aid. They gave as a reason that $150,000 a year was sent abroad for glass. The legislature, in 1793, voted a loan of $3,000 for eight years, free of interest for three years and at 5 per cent for five years. By this time ownership of the works had passed from the De Neufville family to McCallen, McGregor & Company, who conducted the business successfully, but, in 1815, the works closed for lack of fuel. The South Ferry Flint Glass Company, established in 1823 at Brooklyn, had the reputation of making the finest flint glass made in the United States, and at the London Exhibition, in 1851, was awarded a medal.

In the first tariff law of the United States, enacted in 1789, Congress levied a duty of 10 per cent on various kinds of glass. Congress was petitioned, in 1790, to aid the glass works of John Frederick Amelung at New Bremen, Md. The committee of the House of Representatives to whom the petition was referred reported in favor of a loan of $8,000, security to be furnished, but the report was not adopted. In the debate the statement was made that Amelung had expended $200,000 on a plant begun in 1775. Some of the representatives considered that such a petition could be presented to the State more properly than to the Federal government, others objected to the loan on account of the precedent it would establish and others doubted the power of Congress to grant such a loan. About this time the Baltimore Glass Works began making window glass. Between 1760 and 1765, a German named Wister built a glass-house near Allowaystown, N. J. On his failure, at the beginning of the Revolution, the workmen went to Glassborough, N. J., and established a factory, which, still in operation, is the oldest glass factory in the United States. Glass works were started at Temple, N. H., in 1780, window glass works at Keene, N. H., in 1814. Glass was made at New Haven, Conn., in 1789, and at Hartford also about that time.

William Penn, in a letter written in 1683, alluded to a tannery, sawmill and glass works in his colony. In 1769 Henry William Stiegel, a German baron, established at Manheim, near Lancaster, Pa., the largest flint glass factory in the country, in which were produced richly colored bowls and goblets. The first glass works in Philadelphia of which we have a record was a plant for making green bottles and perhaps flint ware, established, in 1771, at Kensington. This plant grew until, in 1831, it was the largest glass works in the United States. It then consisted of four furnaces in which 8,000 pounds of batch were daily melted. In addition to wood and coal, the furnaces consumed 15,000 barrels of resin brought annually from North Carolina. From 250 to 300 men and boys were employed. The product included bottles and apothecaries' vials, the prices for which when imported were extravagantly high. In 1797 a window glass factory was established at Pittsburgh and another at New Geneva, on the Monongahela River, 90 miles south of Pittsburgh. These were the first glass factories west of the Alleghanies. The former was built by Maj. Isaac Craig and James O'Hara, the latter by Albert Gallatin. The former was probably the first in which coal was the fuel, and as late as 1810 wood was the fuel in all glass plants except those in or near Pittsburgh. Writing in 1803, Craig reported an average weekly production of 30 boxes of 100 feet, besides bottles and other hollow ware to the value of one-third of the value of the window glass. He wrote that 8×10 sold at $13.50 and 10×12 at $15 a box. In the earlier years of the industry most factories that made window glass made also bottles and other hollow ware. For many years the imports of window glass exceeded the domestic production.

George Robinson, a carpenter, and Edward Ensell, a glassworker from England, commenced to build a flint glass-house in Pittsburgh, but, lacking sufficient capital, tney sold the unfinished plant, in 1808, to Thomas Blakewell and Robert Page who completed it, and who were the first in the United States successfully to manufacture flint glass. In this plant was produced cut glass not inferior to the best cut glass from Europe. By wagons crossing the mountains, pot clay was hauled from Burlington, N. J., and pearl ash and red lead from Philadelphia, while saltpetre was brought from the caves of Kentucky. Glassmaking in Ohio began at Cincinnati in 1815. The census of 1820 reported "glass window and hollow ware, chemical and philosophical apparatus," to the amount of $19,000 manufactured in Hamilton County, also flint and cut glass and window glass manufactured in Muskingum County. The first glass works in Missouri, which made flint glass tumblers and other ware, were started at Saint Louis, in 1842, by a company headed by James B. Eads, who later built the Mississippi River bridge at Saint Louis and the jetties at the mouth of the river. The second glass works in Missouri, started in 1851, made window glass at Saint Louis.

The ingredients of flint glass were the best of sand, pearl ash, refined saltpetre and oxide of lead. What was known later as German flint or lime glass, a much inferior product, was composed of sand, lime, soda ash and nitrate of soda. In 1864 William Leighton, Sr., of Wheeling, conducted experiments with pure sand, lime; bicarbonate of soda and refined nitrate of soda and produced glass much clearer and more brilliant than any except flint glass. It was called bicarbonate glass at first and lime glass later. The cost for batch was not more than one-third that of a lead batch which it largely supplanted.

An exhibit of pressed glass ware, made by James B. Lyons, of the O'Hara Glass Works at Pittsburgh, received first prize at the Paris Exposition in 1867. At the Centennial Exhibition at Philadelphia, in 1876, one of the attractions was a complete glass works which showed the processes of melting, blowing, pressing, cutting, etching and annealing. The exhibit was made by Gillinder & Sons, of Philadelphia.

Pittsburgh became the centre of the industry, largely because there was in that vicinity an abundance of coal, which was used as fuel in glass-making from 1796 to late in the next century. In 1875 the Rochester Tumbler Works used natural gas for heating lears and partly for furnace heat. About 1880, when wells had been drilled that promised inexhaustible quantities, natural gas began to be very extensively used for lear heating and batch melting. It provided a cheap fuel, perfectly adapted to the industry, and thereafter glass manufacturing greatly developed in western Pennsylvania and West Virginia, and later in the gas regions of Ohio, Indiana, Illinois, Missouri, Kansas and Oklahoma. When the supply of natural gas became exhausted many factories closed or moved to new gas fields, but in recent years many factories have begun to use artificial gas produced from coal in the plants, and some are now using oil for fuel. Even in the Pittsburgh district the price of natural gas is now so high that producer gas is used to some extent in glass making. Oil or producer gas is used by all plants east of the Alleghanies. The Eastern plants, at a disadvantage regarding natural gas, have the advantage of nearness to the larger markets.

The regenerative furnace, an invention of Siemens, first used for melting glass in 1861, was soon adopted in America. By this method the waste heat from the gases generated by combustion was utilized for heating, and much fuel was saved, the melting time reduced, the output increased and the quality of the product improved. Another revolutionary invention for batch melting was the tank. In pot furnaces the batch is melted in separate pots, which are placed around the inside furnace walls, while with tank furnaces the tank occupies the whole furnace area. There are day tanks and continuous tanks. The latter enable a plant to work to capacity 24 hours a day. Tanks were introduced into America in 1889, after they had been used in Belgium. During the last 30 years many pot furnaces have been replaced by tank furnaces. The only efficient establishments that now use pots are those that make plate glass, very fine qualities of table ware and other fine goods, or a great diversity of colored glass. Until recent times the making of glass was a handicraft, and many glass articles are still shaped by the breath of a blower. Machinery has been invented and improved chiefly for the manufacture of window glass, plate glass, bottles, table ware and lighting goods.

Crown window glass was made in Massachusetts from 1792 to 1826. A bulb was blown, opened, flared out into a disc, cut into half circles and then into panes. The cylinder process for making window glass was introduced from Europe after 1830. The cylinders, blown on a blow-pipe, were cracked into lengths, split lengthwise and flattened. The great development in window glass manufacture dates from about 1880, when natural gas began to be largely used. At a window glass factory which he erected at Jeanette, Pa., James Chalmers began, in 1889, to use the first continuous tank in this country. The first successful machine for making window glass, constructed under the Lubbers patents, was installed by the American Window Glass Company at Alexandria, Ind., in 1903. In this machine and in other types later invented by Americans, the glass is drawn by a "bait member" from the "metal" in the tank, and the cylinder is formed by a pressure of air in it controlled by an operator. During the blast of 1915–16 the production of 50-foot boxes by hand was 3,708,000 and by machine 5,575,000, the hand production being about 40 per cent of the total. In 1916 there were in the United States 51 plants, with 1,737 pots, in which window glass was blown by hand, and 25 plants with 296 window machines. The introduction of machinery led to the production of more window glass than the domestic consumption, with the result that window glass factories are usually operated only seven or eight months a year. Census figures show that the average value of a 50-foot box was $2.51 in 1899, $2.39 in 1904, $1.70 in 1909 and $2.18 in 1914. About 1908 Irving W. Colburn invented a machine by which glass is drawn from a tank in continuous sheet form. The sheet passes between rollers, and an operator controls the thickness and width. The Colburn patents were purchased by the Owens Bottle Machine Company, which, in 1917, erected at Charleston, W. Va., a factory for making sheet window glass.

Under the management of Cuthbert Dixon, a plate glass worker and manufacturer from London, England, rough plate glass was produced in 1852 at Williamsburg, L. I. A window glass factory erected at Cheshire, Mass., in 1850, was changed, in 1852–53, to a rough cast plate factory. A window glass factory erected at Lenox Furnace, Mass., in 1853, was converted, in 1855, into a plate glass factory. The successful establishment of the plate glass industry was chiefly due to James B. Ford of Pittsburgh. In 1869 he visited the works at Lenox and learned what he could from foreign plate glass workers there. Then he started a factory at New Albany, Ind., for which he imported grinding, smoothing and polishing machinery. This factory, from which he withdrew in 1872, was successfully continued by William C. De Pauw. Ford later built plate glass factories at Louisville, Ky., Jeffersonville, Ind., Creighton, Pa., and Tarentum, Pa. A plate glass plant was established, in 1872, at Crystal City, Mo. In 1917 there were nine plate glass plants in Pennsylvania, two in Missouri and one each in Michigan, Ohio, Indiana and Illinois. The 15 plants in the United States had 113 furnaces and 2,116 pots. From 1875 to 1915 the price of plate glass decreased about 75 per cent. The first process for manufacturing wire glass successfully was patented by Frank Shuman in 1892. Since 1890 there has been successful development in this country in the manufacture of cathedral, opalescent and art sheet glass, and all kinds of figured, ribbed and colored glass.

Machines for blowing bottles, at first adapted to wide-mouthed bottles only, were not commercially successful until about 1896. Such machines were operated at first by three skilled men, later by two and now by one. In 1908 there appeared a three-man machine for making narrow-necked bottles; in 1912, a one-man machine for wide-mouth bottles, and, in 1914, a one-man machine for narrow-neck bottles. The one-man machine automatically cuts off the quantity of molten glass sufficient for each mold. In establishments using machines bottles are blown by hand to fill small orders. From the earliest period of glass blowing until 1903 all glass that was blown was gathered on the end of a blow-pipe. In that year two revolutionary inventions were commercially introduced, the bottle-making machine by Michael J. Owens and the flowing device invented by Homer Brooke, both Americans. With only an attendant, who is not a skilled operator, the Owens machine gathers the glass and blows the bottle or jar. When a mechanical conveyor is used, the ware is both made and delivered to the lear without handling. More nearly automatic than any other glass-making machine, its output is much greater. The operating speed of the largest type of Owens machines is indicated by the fact that it produces more than 75,000 quart fruit jars in 24 hours. The machine and the revolving tank that supplies it are costly and are used only in factories which produce large quantities of bottles or jars of uniform shape and size. The machines were introduced in Europe and more recently in Japan. By the Brooke device the molten glass flows from the furnace to the mold, the quantity sufficient for each mold being automatically severed. The chief advantages of the Brooke device are that it dispenses with skilled labor; it can be operated during the hot months when hand gatherers are not readily obtainable, and by it the output is increased while the cost of production is decreased.

The making of coal-oil from coal led, about 1855, to a demand for lamps and lamp chimneys, the use of which greatly increased, about 1859, when refined petroleum was first marketed. One of the first plants to make a specialty of lighting goods was started in Brooklyn by Christopher Dorflinger, in 1852, but, in 1865, he moved the business to White Mills, Pa., where he established a large cut-glass factory. Lamps and lamp chimneys are still manufactured in considerable quantities and exported to many countries. Chimneys were at first blown off-hand on blow-pipes. Chimneys, light tumblers and other seamless blown ware are now made in paste-mold machines, the seams being removed by turning the ware while hot in molds lined with carbon or similar material. The incandescent lamp was perfected by Edison in 1879 and its manufacture became an important branch of the industry. The bulbs are blown in paste-mold machines. All kinds of lighting goods are now extensively made in the United States.

The popularity of American made cut glass was established by a splendid display by the Libby Company in a complete glass-melting and cutting establishment at the World's Fair, Chicago, in 1893. Both pressed ware and deep-cut ware were exported to Europe before the war there began. Laboratory ware was little made in the United States before the war began in Europe, but since 1914 it has been produced here in quantities sufficient for domestic consumption and for export. Beakers and flasks equal to Jena ware have been made by one factory in New Jersey since 1900 and by plants in several States since 1914. Photographic glass was first made commercially in the United States in 1911 and the domestic production is now large. Optical glass was made experimentally in the United States in 1912. As a result of the war, the quantity manufactured here became large, the quality being equal to the best European product.

Even with the extensive use of machinery, labor constitutes the chief single item of expense in the manufacture of glass. Of 334 industries reported by the census of manufactures for 1914, glass ranked thirteenth in percentage of labor cost based on the value of the product. A government report, issued in 1917, shows that of the total sales value of the product, the cost of labor in the manufacture of various kinds of glass was 40.6 per cent. The same report shows that of employees in glass factories, 2.5 per cent were under 16 years of age and 8.2 per cent women, the latter being more numerous in tableware and lighting goods factories than in plants of other kinds. Hand window-glass blowers receive higher wages than skilled workers in other branches of the industry, and their working hours are relatively short, union hours being 44 a week. Unskilled workers average about 60 a week. Skilled labor is paid at piece rates, unskilled on a time-rate basis. In manufacturing window glass by hand and also blown and pressed ware, which includes tableware, bar goods, lighting goods and laboratory ware, the labor unions limit the output of workers, which restricts production and increases cost. Some branches of the industry operate only a part of the year, hand window glass only about seven months and machine window-glass plants about eight months, while other branches lose one or more months a year. The reasons are fear of overproduction, inability of men to work around furnaces during the hot months and necessity for repairs.

Accompanying tables show statistically the development of the industry in the United States from 1869 to 1914. While the estimated population increased 19.6 per cent from 1904 to 1914, the value of glass manufactures increased 54.6 per cent. Of the total value, $123,085,019 in 1914, window glass amounted to $17,495,956; polished plate glass, $4,554,326; pressed and blown ware, $30,279,290; bottles and jars, $51,958,728; other products, $4,022,932. In window glass, plate glass, pressed tableware, deep cut ware, lighting goods, laboratory ware and optical goods, the quality of the domestic product is equal or superior to the best that is imported.

The imports and exports of glass and glassware during the fiscal year 1879 were respectively $3,281,543 and $768,644; during the fiscal year 1914, respectively, $8,219,112 and $3,729,623.

The imports were 15.5 per cent of the domestic production, $21,154,571, during the calendar year 1879, and 6.7 per cent of the production, $123,085,019, in 1914. The average rate of duty was 57.6 per cent in 1879 and 33.8 per cent in 1914. Before the war in Europe began the principal glass importations were window glass, plate glass, fine blown tableware, toilet ware, colored ware, optical glass and bottles used as containers. Since the war began imports have suspended and exports increased many fold. Of the imports in 1914, window glass amounted to $1,316,902, of which over 80 per cent was of the three smaller brackets (384 square inches and under), and plate glass amounted to $489,359, also mostly of the smaller sizes. Practically all of the imports of window and plate glass in recent years have been in localities on or near the Atlantic, Pacific and Gulf coasts. The exports include all kinds of glass and glassware made in America.

An extended account of the development of the industry by Joseph D. Weeks appeared in the census report on manufactures 1880. A report on the industry by the undersigned, published by the Bureau of Foreign and Domestic Commerce, 1917, contains a bibliography with 500 titles.

Walter B. Palmer,
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GLASS PAINTING. See Glass Staining.

GLASS SAND, sand used in glass-making, obtained either from sand deposits or from quartzites by crushing to the requisite degree of fineness. Deposit sand must be washed to free it of impurities. Silica is the chief constituent. Glass sand is found principally in Pennsylvania and Illinois, about $1,500,000 worth being raised in normal years. Consult Merrill, 'Non-Metallic Minerals' (New York 1910) and Ries, 'Economic Geology' (3d ed., ib. 1910).

GLASS SNAIL, one of the minute, grass-haunting, hyaline land-snails of the genus *Vitrina.*

GLASS-SNAKE, or **JOINT-SNAKE,** a limbless, snake-like lizard of the genus *Ophisaurus* (family *Anguida*), which takes its name from the brittleness of the tail, which is more than twice the length of the body, and whose vertebræ are so slightly connected, that a part or all of the tail will easily break off, or may be cast off; but the lost part is quickly renewed. The head is very lizard-like. No vestige remains of limbs except two little spikes near the vent; the body is serpentiform, but the stiff armor of scales prevents the graceful movements of a serpent. The glass-snake (*O. pallasi*) of southeastern Europe may exceed a yard in length, and dwells in bushy districts where it can hide under leaves and sand, and catch snails and small animals. A smaller species (*O. ventralis*) is found in the Mississippi Valley and the southern United States. It is

Glass Industry in the United States, General Statistics, 1869–1914.

(Source: Census of Manufactures).

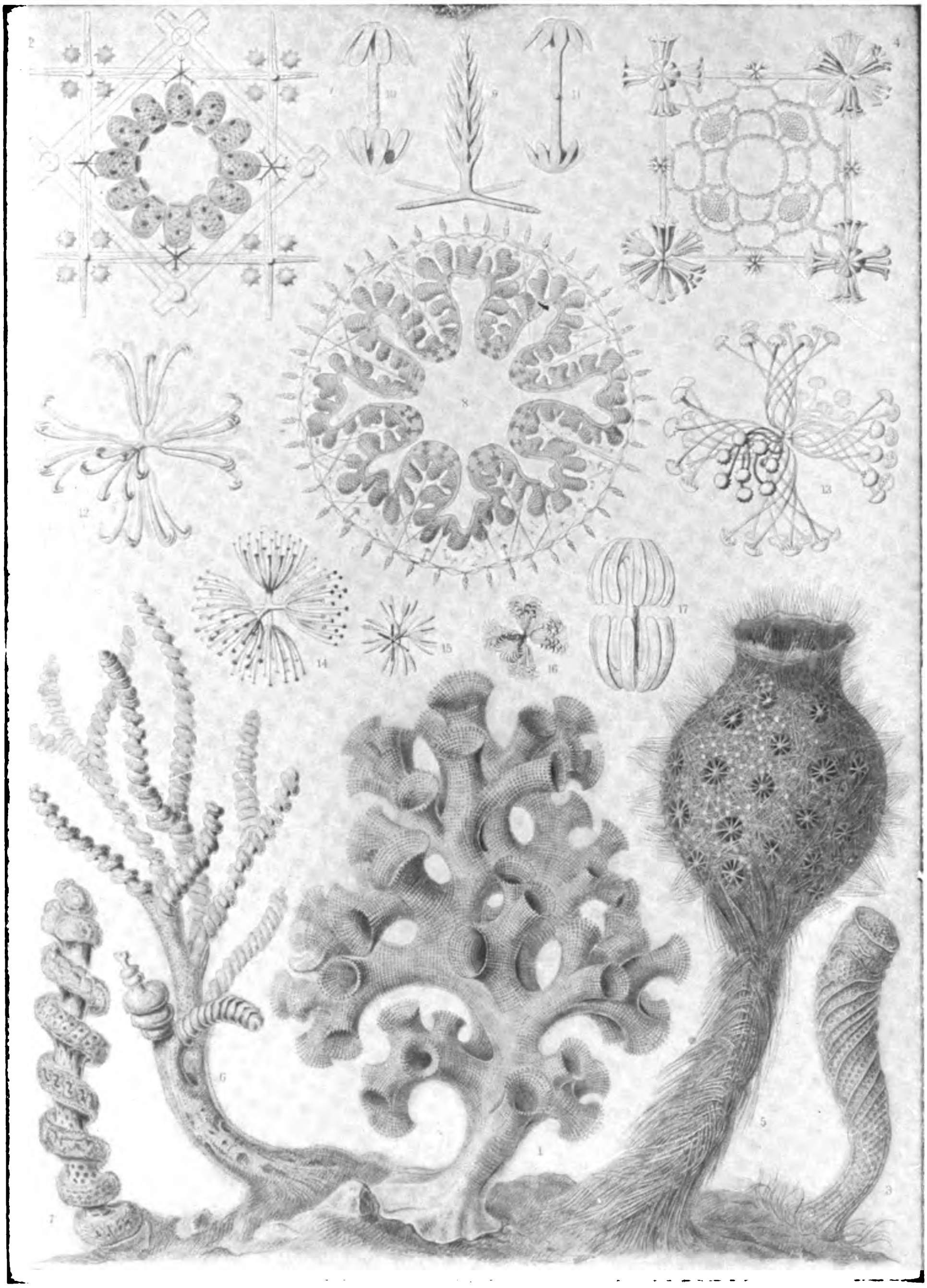
	1869	1879	1889	1899	1904	1909	1914
Establishments	154	169	294	355	399	363	348
Capital	$13,826,142	$18,804,599	$40,966,850	$61,423,903	$89,389,151	$129,288,384	$153,925,876
Wage earners	15,367	24,177	44,892	52,818	63,969	68,911	74,502
Salaries and wages	$7,589,110	$9,144,100	$22,118,522	$29,877,086	$41,228,441	$44,293,215	$55,204,723
Cost of materials	5,864,365	8,028,621	12,140,985	16,731,009	26,145,522	32,119,499	46,016,504
Value of products	18,467,507	21,154,571	41,051,004	56,539,712	79,607,998	92,095,203	123,085,019

Value of Glass Production in the United States, 1879–1914.

(Source: Census of Manufactures).

STATES	1879	1889	1899	1904	1909	1914
Pennsylvania	$8,720,584	$17,179,137	$22,011,130	$27,671,693	$32,817,936	$39,797,822
Ohio	1,549,320	5,649,183	4,547,083	9,026,208	14,358,274	19,191,342
Indiana	790,781	2,995,409	14,757,883	14,706,929	11,593,094	14,881,372
West Virginia	748,500	945,224	1,871,795	4,598,563	7,779,483	14,631,171
Illinois	901,343	2,372,011	2,834,398	5,619,740	5,047,333	7,680,343
New Jersey	2,810,170	5,218,152	5,093,822	6,450,195	6,961,088	7,597,754
New York	2,420,796	2,723,019	2,756,978	4,279,766	4,508,790	5,156,714
Missouri	919,827	1,215,329	765,564	1,781,026	1,992,883	3,882,420
Oklahoma	....	....	....	*	*	2,005,736
Maryland	587,000	1,256,697	557,895	589,589	1,038,368	1,500,982
Kansas	....	....	....	958,720	2,036,573	728,681
Virginia	....	....	*	549,031	681,900	690,420
Massachusetts	254,345	431,437	418,458	1,011,373	*	*
All other States	851,905	1,065,397	924,706	2,365,165	3,279,481	5,340,263
United States	$21,154,571	$41,051,004	$56,539,712	$79,607,998	$92,095,203	$123,085,019

* Included in all other States.



FLINT OR GLASS SPONGES

1, 3, 5, 6, 7 Various forms of glass sponges
2, 4, 9, 10, 11, 12, 13, 14, 15, 16, 17 Specimens of flint or glass spicules which form the skeleton of the animals
8 Cross section of a young sponge

greenish-gray or brownish; sides largely yellow, with narrow black streaks; but the coloration varies greatly, especially in western specimens. Several nearly related species inhabit Central America. These lizards are rapacious and devour great numbers of ground-keeping insects and crayfish. They breed by means of eggs hidden in loose soil or leaves; and are of slow growth. They are said to be easily tamed and to show intelligence.

GLASS-SPONGES, certain silicious sponges are so-called from the fact that the fibres or spicules composing their solid framework or skeleton is like finely spun glass. The glass-sponges, such as the Venus' flower-basket (*Euplectella*) and allied forms, live in fine sandy mud in deep water. The *Euplectella* inhabits the ocean around the Philippine Islands in from 10 to 20 fathoms. It forms a hollow cylinder or basket-wcrk of spicules, enlarging at the top, which is broad and a little convex; it grows rooted in the sandy mud, anchored by its long glass spikes, which at the extremity end in anchor-like hooks. A number of similar but shorter, more dense sponges (*Holtenia,* etc.) live at great depths in the Atlantic, one kind occurring in shallower water (100 fathoms) in the Gulf of Maine. The glass-sponge of the Japanese seas is *Hyalonema,* in which the stem is twisted, composed of fibres, like spun glass, while the body of the sponge is long and slender; it grows nearly three feet in length. These glass-sponges, with the spicules having three crossed axes, or six threads radiating from a common point, are grouped in a family (*Hexactinellidæ*). The efferent canals are loosely meshed, while the digestive chambers (ampuliæ) are large and barrel-shaped.

GLASS STAINING AND GLASS PAINTING, the art of producing pictures on glass with vitrifiable colors; but a common extension of the meaning is to include all the make and design of ornamental glass windows. Originally there was but one method of making these, and that was to produce the pattern in outline with frames, into the grooves of which pieces of colored glass or of stained glass were fitted. In the Moslem East these frames were of plaster, or rarely of marble slabs pierced with openings. In Europe, since the 12th century, these frames have been of lead, rolled or drawn into what are called *cames,* that is, bars of an I section, the two grooves holding the glass firmly. Modern chemistry has so improved the art of glass staining that large pictures may now be produced on single sheets of glass, but nowhere have such pictures been successful in an artistic sense. In the original painted glass windows the pictures resembled tables of mosaic work, in which there was no attempt at shading or modification of the tone. What is perhaps the earliest known application of colored glass to window decoration, in Europe, is that in the monastery of Tegernsee, in Upper Bavaria, which was secularized in 1802, and is now a private residence. The windows of this structure, executed in the latter half of the 10th century, like all the first attempts, were only tasteful arrangements of colored glass in a translucent mosaic.

In the early part of the 13th century the mosaic patterns gave way to more elaborate designs, not only in beautiful arabesques, but even in pictorial composition. In all these the figures were composed of pieces of colored glass combined with marvelous skill and taste. The work of shading and making so-called half-tints was not attempted; but an effect not dissimilar was got by painting in opaque pigment upon the glass and breaking up this painted surface into patchings and spots as when an artist draws in crayon or charcoal. The finest English examples of this early mosaic work are to be found in the cathedrals of Canterbury, Salisbury and Lincoln. In the 14th century the art of shading was advanced by removing certain portions of the colored surface. The first period of the art reached the culminating point in the 15th century, but with the passing of Gothic architecture, glass painting lost its artistic spirit. Subjects in which were arranged a multitude of personages with all the elaborate artifices of pictorial composition; buildings showing complex linear perspective; foreshortened figures; the play of light and shade — all this was attempted to be exhibited in painted windows. It soon became apparent that the true art was lost, and though windows continued to be painted, only a few artists acquired celebrity. Perhaps the best examples of the 15th century period are the windows of the Cologne Cathedral.

About 1600, Bernhard von Linge, an artist from the Netherlands, residing in England, and who may be considered the father of the modern art of glass staining, established a school in London, whose influence is evident in the work of the present day. Francis Eginton (1737–1805), a native of England, accomplished much to restore the art during the 18th century. Among his numerous works, all of which are remarkable for brilliancy of coloring and delicacy of execution, are 'The Banquet of the Queen of Sheba' (a copy from Hamilton); two 'Resurrections' (from Sir Joshua Reynolds); 'Christ Bearing the Cross' (from Morales); and 'The Soul of a Child' (from Peters). Other famous artists of this period were Jouffrey and Baumgartner. The Renaissance in glass painting was contemporaneous with the revival of Gothic architecture in the beginning of the 19th century. Four German artists, Mohn, Scheinert, Ligm and Frank, were prominent as glass stainers during the century. In 1850, through the generous assistance of King Louis of Bavaria, a school was founded at Munich under the direction of Gärtner and Hess, the latter a well-known historical painter, which obtained a world-wide celebrity. Still, however, the purists in Gothic art, and those who were most concerned in the Gothic revival would have none of this glass of the early 19th century. It was seen that the smooth and clear modern glass would never do; and rough, partly opaque, flawed and bubbled glass was prepared on purpose. This material, known as «antique» and as «cathedral» glass, and by other names, allowed of a far more decorative effect.

The chief centres of the art in Europe are at Birmingham, England; Edinburgh, Scotland; Paris and Sèvres, France, and Munich, Metz and Nuremberg in Germany.

Not until comparatively late in the 19th century did the art of glass staining obtain a place in the United States. Only a few years ago Americans were seemingly content with imported windows, or with poor imitations made here. In both cases the windows were but copies of mediæval work, seldom equaling the originals, and never showing an advance, either in artistic qualities or improvement of method over the windows of the Middle Ages. Several artists and some makers of church furniture began making fine windows, and to-day largely through their efforts American colored glass windows have become celebrated for their color values and their color relations. John La Farge, Louis C. Tiffany and other American artists in glass painting and glass staining took up the art where the mediævalists stopped, in the study of the inherent properties of the glass, both in their color and texture, in order to obtain in the glass itself light and shade, through depth and irregularity of color, in union with inequality of surface. In this way they sought to avoid the dullness, opacity and thinness which invariably accompany the use of paint, and are marked characteristics of European glass work. It was an American idea to make glass in lumps and chip it into flakes, to corrugate it, to blow it into shapes, or to pull molten glass out of shape. By such means the artist has succeeded in obtaining effects in this obstinate material which were deemed impossible. There was introduced a few years since the use of opalescent glass, the plating of glass over glass and developing the mosaic system, substituting it for glass painting. Churches, houses, hotels and theatres are now decorated by the mosaic stained glass which is largely a product of New York studios. Upward of $5,000,000 are invested in the stained glass industry in the United States.

GLASSE, glas, **Hannah,** English writer. She was the author of 'The Art of Cookery' (1747) a volume which became popular. In the fourth edition (1770) she is described as a habit-maker in Tavistock street, Covent Garden.

GLASSPORT, Pa., borough of Allegheny County, 10 miles south of Pittsburgh, on the Monongahela River, and on the Pittsburgh and Lake Erie Railroad. It has manufactures of tools, steel hoops, spikes, rivets, glass, foundry products, etc. Coal mining is the principal industry. Pop. 5,540.

GLASTONBURY, Conn., town in Hartford County, seven miles southeast of Hartford, on the Connecticut River. It has manufactures of soap, woolens, paper, silverware and a large trade in tobacco and agricultural produce. Pop. 4,796.

GLASTONBURY, England, market-town and Borough of Somerset, on the Brue, 25 miles southwest of Bath. Its site was once an island, but now forms a peninsula. It was originally called Inis Vitrin, or Isle of Glassy Water, and later became known as Inis Afalon, or Isle of Apples. It has many interesting historical features. It is famed for its abbey, which dates back to the year 708, when it was built by the Saxon, Ina, in place of the British monastery founded about 601. The abbey is a ruin, and includes different periods of architecture. The ruins of the church, Saint Joseph's Chapel, and the Abbot's Kitchen, are the only buildings extant. There is a legend that Joseph of Arimathea came over to Glastonbury and founded a church there; moreover, he is stated to have planted a graft from the sacred thorn there. Glastonbury Tor is a hill upon which the last abbot of the monastery suffered capital punishment for "divers and sundry treasons," in 1539. A lake-village dating back to the Celtic period was uncovered nearly in 1892. Pop. 4,250. Consult Gasquet, Cardinal, 'The Last Abbot of Glastonbury' (London 1908); Hearne, 'History and Antiquities of Glastonbury' (Oxford 1722).

GLAUBERITE, glâ'bėr-īt, a mineral having the formula $Na_2SO_4CaSO_4$, and crystallizing in the monoclinic system, usually in tabular forms. It is commonly pale yellow or gray in color, with a white streak. It has a hardness of from 2.5 to 3, and a specific gravity of from 2.7 to 2.85. Glauberite occurs in connection with rock salt in various parts of the world. In the United States is found at Borax Lake, San Bernardino County, Cal., and in tabular crystals in the Rio Verde Valley, Arizona.

GLAUBER'S (glow'bėrz) **SALT,** sulphate of sodium, Na_2SO_4, so called from the German chemist, Glauber, who prepared it in 1658 by distillation of common salt with sulphuric acid, named it "sal mirabilis," identified it with the salt of beneficial mineral water and urged its good qualities. It occurs throughout Europe, especially at Carlsbad and Seidlitz, and in North America, notably at the Great Salt Lake in Utah. It forms oblique prisms which effloresce on the soil or on rocks. These are of a gray or yellow color, earthy, but transparent and vitreous when newly broken. It is readily soluble in water, and when heated or exposed to the air melts in its water of crystallization. Its chief use is in the manufacture of glass and sodium carbonate.

GLAUCHAU, glow'chow, Germany, town of Saxony, on the Mulde, eight miles northeast of Zwickau. It has two ancient churches, two castles, a Rathaus, a school of weaving and a technical college. It has extensive textile factories, numbers of dyeing establishments and manufactures of timber, paper, brick, machinery, etc. Pop. 25,155.

GLAUCINE, glâ'sīn, an alkaloid contained in the leaves of *Glaucium flavum,* a sort of poppy. The leaves are macerated with acetic acid; the juice is pressed out, boiled, filtered and the filtrate is treated with lead nitrate, which precipitates lead fumarate. The filtrate is treated with H_2S, then the glaucine is precipitated with tannin, and the precipitate decomposed by chalk. Glaucine crystallizes out of water in small scales, is easily soluble in alcohol and ether and forms crystalline salts.

GLAUCODOT, glâ'kō-dŏt, or **GLAUCODOTE,** an orthorhombic, grayish, tin-white mineral of metallic lustre and black streak; hardness, 5; specific gravity, 6. Composition: Sulphur, 19.4; arsenic, 45.5; cobalt, 23.8; iron, 11.3. It occurs in chlorite slate in the province of Huasco in Chile, also in fine crystals in Sweden.

GLAUCOMA, glâ-kō'ma, a diseased condition of the eyeball characterized by a retention of the fluids within its cavity. As the fluids accumulate, pressure is exerted on the delicate lining, with resulting injury or destruction of sight. It is due to any causes operating so as to close the place of exit for the fluids of the inner chamber of the eyes. See EYE.

GLAUCONITE, an amorphous green opaque mineral, like earthy chlorite, with a dull or glistening lustre. It is a hydrous silicate of iron and potassium, variable in composition, but averaging: Silica, 49.3; alumina, 3.6; sesquioxide of iron, 22.7; protoxide of iron, 6.3; potash, 8.3, and water, 9.6. Its hardness is 2, and its specific gravity about 2.3. There are two varieties of it; the one the green earth of cavities in eruptive rocks, the other the green grains in greensand formation. The latter, because of its potash content, is used locally as a fertilizer, along the Atlantic seaboard. The amount of potash ranges from 2.2 to 7.9 per cent in ordinary varieties such as occurs extensively in upper Cretaceous and lower Eocene strata of New Jersey, Maryland and Virginia. Occurs also in grains in upper Cambrian sandstone in various parts of the Rocky Mountain region and southward.

GLAUCOPHANE, glâ'ko-făn, a mineral of the amphibole group, crystallizing in the monoclinic system, and closely resembling amphibole in form. It is a silicate of aluminum, sodium, iron and magnesium, with variable proportions of the two latter metals. It is blue or gray in color, translucent with a vitreous lustre, and has a hardness of from 6 to 6.5 and a specific gravity of about 3.1 Glaucophane occurs in certain crystalline and mica schists, and is found associated with mica, garnet, epidote and diallage. In the United States it occurs chiefly along the Coast Ranges of California.

GLAUCUS, glâ'kŭs, the name of several personages in Greek legend. (1) A sea-god, who was at first only a fisherman, and whose oracles were highly prized by fishermen, according to the legends. (2) The son of Hippolochus and grandson of Bellerophon. He assisted Priam in the Trojan War, and was foolish enough to exchange his golden armor for the iron suit of Diomed. He displayed much courage, but was killed by Ajax. (3) The son of Sisyphus, king of Corinth, by Merope, daughter of Atlas, and born in Potnia, Bœotia. He wished to make his mares swifter than others, for the purpose of vexing Venus, and Venus inspired the animals with such fury that they tore Glaucus to pieces as he returned from the games which had been celebrated by Adrastus in honor of his father. (4) The son of Minos II, and Pasiphæ, smothered in a cask of honey, and miraculously brought to life, by an herb sent by Polyidus the soothsayer.

GLAZE (ceramic), a vitrified coating which gives to earthenware or porcelain its brilliance and impermeability.

Glazes are of three classes: The glaze proper (Fr. *couverte*), a soft glaze (Fr. *vernis*) and the enamel or opaque glaze (Fr. *émail*). The glaze proper is a silicate of calcium, potassium and aluminum and is composed of feldspar chalk or whiting, kaolin and quartz. It is applied either to the clay ware (Chinese) or to the soft burned biscuit (modern); the whole piece is then burned to a high temperature (about 1,500° C.). Soft glaze comprises the vast range of earthenware and faïence glazes and includes the glazes of bone china and soft porcelain. A soft glaze is either a silicate or a boro silicate, and the bases employed include the oxides and carbonates of the following elements: Lead, zinc, potassium, sodium, calcium, barium, magnesium, and as coloring agents the salts of iron, cobalt, copper, nickel, antimony, chromium and manganese.

The range of temperature is very wide. A simple lead glaze will fuse at 900° C. and a hard glaze for white earthenware may need 1,350° of heat. Enamels are sometimes used over other glazes and sometimes upon the biscuit body. Their essential condition is opacity. Oxide of tin, alumina, calcium phosphate and calcium carbonate are used as opacifiers. The early wares made in Italy, Spain and Holland were of this type. (See MAJOLICA). For convenience of application glazes are ground in water and held in suspension, the article to be glazed being plunged into the liquid. For this reason only insoluble substances can be used, and where it is necessary to introduce alkaline salts and soluble boric acid or borates these are rendered insoluble by being melted with insoluble and readily combined reagents, such as whiting and barium carbonate. This melt is called a «frit» and the operation of melting is known as «fritting.» Hence some glazes, mainly of the second class, are called fritted glazes, and glazes which contain no frit are termed «raw» glazes. Fritted glazes are, as a rule, harder and clearer than those which contain no frit except in the case of porcelain glaze (couverte), which is made from natural substances without frit.

GLAZEBROOK, Richard Tetley, English scientist: b. 18 Sept. 1854. He was educated at Cambridge and was principal of University College, Liverpool, 1898–99, has been director of the National Physical Laboratory from 1899. He has published various scientific textbooks and ‹Laws and Properties of Matter›; ‹Clerk-Maxwell and Modern Physics,› etc.

GLAZIER LAKE, Minn., a body of water south of Lake Itasca, into which it empties through a swift and permanent stream about six feet wide; named for Capt. Willard Glazier, who claimed for it a geographical importance as the true source of the Mississippi. Lake Glazier has an area of 255 acres. It is estimated to be 1,582 feet above the Atlantic, and 3,184 miles from the Gulf of Mexico.

GLEANERS, The. See GLANEUSES, LES.

GLEASON, Elliott Perry, American inventor: b. Westmoreland, N. H., 27 June 1821; d. New York, 26 Sept. 1901. Received a common school education; was one of the first to manufacture gas burners; and invented the regulating argand burner and other lighting devices.

GLEASON, Frederick Grant, American musician: b. Middletown, Conn., 17 Dec. 1848. He was a pupil of Dudley Buck at Hartford, Conn., studied also at Leipzig, Berlin and London, became an organist at Hartford, and in 1876 removed to Chicago, where he was active as composer, teacher and musical critic of the *Tribune*. Among his works are songs, trios, sonatas; the cantatas, ‹Praise of Harmony,› ‹God Our Deliverer› and ‹The Culprit Fay›; and the operas ‹Montezuma› and ‹Otho Visconti.›

GLEBE, glēb (Lat. «soil,» «clod»), the land possessed as part of the revenue of an ecclesiastical benefice in England or Scotland, often scattered through the parish. Where there are arable lands the glebe must consist of 4 acres; where there is none the parson is entitled to 16 soums of grass next adjacent to the church — a soum of land being as much as will pasture 10 sheep or one cow—so that the actual extent will vary with the richness of the soil. The glebe must be taken as near the manse as possible; and where there is no manse, vicinity to the church is the criterion. In general, the glebe is the subject of much discussion in the ecclesiastical law of both countries. Although the incumbent is temporarily proprietor, he has no right of alienating the glebe.

GLEDE, glēd, an old British name for a bird of prey, the kite. See KITE.

GLEE, in music, a vocal composition in three or more parts, generally consisting of two or three contrasted movements, the subject of which may be either gay, tender, grave or pathetic. It is distinguished from a madrigal by its want of contrapuntal harmony, and in the independence of its parts it differs from a part-song. It is essentially English in origin and cultivation, and the period during which its vogue was greatest and its form most perfect extended from 1760 to 1830.

GLEET, glēt, chronic urethritis; an obstinate inflammation of the urethra that follows acute gonorrhœa. The disease is evidenced by the continuation of the purulent discharge, or by a morning drop, or by the presence of shreds of mucous membrane appearing in the urine. It may be due to small ulcerated patches, the presence of a stricture, or inflammation continuing in the tiny pockets and glands. The cure of the inflammation requires astringent and antiseptic injections usually some form of silver, and under some conditions the passage of steel sounds.

GLEICHENBURG, glī'ʜen-boorg, Austria, a watering-place of Styria, over 1,000 feet above sea-level, near the frontier of Hungary, 40 miles south of Graz. It contains saline alkali springs which are frequented by thousands annually, and the waters from which are exported. Pop. 1,500.

GLEIWITZ, glī'wits, Prussia, town in the province of Silesia, on the Klodnitz and Klodnitz Canal, 100 miles southeast of Breslau. It contains a very old church, gymnasium, technical and vocational schools, a museum, and its industries consist of iron foundries, boiler and wire works, farm implement works, paper, glass, oil, chemical and pipe works, etc. The town was founded in the 12th century. Pop. 67,000.

GLEN RIDGE, N. J., borough of Essex County, on the Delaware, Lackawanna and Western and the Erie railroads, four miles from Newark. It is the seat of Mountainside Hospital and has a public library. It is a residential suburb of the neighboring great cities of New York, Newark, Jersey City. The borough owns the waterworks. Pop. 3,260.

GLENCOE, glĕn'kō, Minn., village and county-seat of McLeod County, on Buffalo Creek, on the Chicago, Milwaukee and Saint Paul Railroad, 51 miles southwest of Minneapolis. Stevens Seminary and Saint Joseph's Academy are located here. It is the centre of a farming and dairying region, and its industrial establishments comprise flour mills, grain elevators, foundries and machine shops. The waterworks are the property of the village. Pop. 1,728.

GLENCOE, Scotland, a valley in Argyllshire, running for 10 miles east from Ballachulish to Loch Etive. It is famous as the scene of the massacre of the MacDonalds on 13 Feb. 1692. (See SCOTLAND, *History*). Consult Gilfinnan, George, 'The Massacre of Glencoe and the Campbells of Glenlyon' (Stirling 1913) and Macaulay, T. B., 'History of England' (3 vols., New York 1908).

GLEN COVE, N. Y., city of Nassau County, Long Island, 25 miles northeast of Brooklyn, on Long Island Sound and on the Long Island Railroad. It contains a library, public schools and a Friends' Academy. It is mainly a residential suburb of the metropolis and has a few local industries. Pop. 7,500.

GLENDALE, Cal., city of Los Angeles County, north of Los Angeles. It contains a sanitarium, Carnegie library and a high school. Oranges and olives are grown extensively in the vicinity. The city owns and operates the electric-lighting plant. Pop. 2,746.

GLENDALE, Battle of, also called **THE BATTLE OF CHARLES CITY CROSS-ROADS, THE BATTLE OF FRAZIER'S FARM,** and **THE BATTLE OF WHITE OAK SWAMP.** The battle of Gaines' Mill was fought on 27 June 1862. That night the Fifth corps and its supports crossed to the south side of the Chickahominy and destroyed the bridges, and the withdrawal of the Army of the Potomac to James River began. The battles of Allen's Farm and Savage Station were fought on the 29th, and on the morning of the 30th the Union army was across White Oak Swamp Creek, covering the roads leading to James River and the immense trains on their way to Malvern Hill and Harrison's Landing. Franklin, on the right, with Smith's division of his own corps, Richardson's division of Sumner's and Nagle's brigade of Keyes' corps, was at the bridge crossing of White Oak Swamp Creek. About two miles to the left, holding the intersection of the Charles City, Darbytown and New Market roads, thus covering the Quaker road over which the trains must pass, was Sumner, with Sedgwick's division of his own corps, Heintzelman's two divisions of Hooker and Kearny, Slocum's division of Franklin's corps, and McCall's division. Slocum, on the right of Sumner's line, was on the Charles City road, about a mile in advance of the junction with the New Market and Quaker roads; Kearny was on Slocum's left between the Charles City and New Market roads; McCall was on Kearny's left, and Hooker to the left and rear of McCall; Sedgwick was in support to McCall, but during the forenoon, two of his brigades were sent to Franklin. Porter's and Keyes' corps were at or on the way to Malvern Hill. After making these dispositions McClellan left the field.

General Lee's plan contemplated that Jackson should force a passage at the bridge held by Franklin, turn his right and reach the Union rear; Holmes to attack and turn the Union left and prevent its reaching James River, while the divisions of Longstreet, A. P. Hill and

Huger, supported by Magruder, concentrating at the cross-roads, should cut McClellan's army in two and interrupt its retreat to the river. Early on the morning of the 30th Jackson advanced through Savage Station on Franklin, who opened upon him furiously with artillery and checked him. It was a great disappointment to Lee, and Jackson's want of enterprise on this occasion has been the subject of much criticism. Holmes advanced on the Confederate right with 6,000 men and 6 batteries, toward Malvern Hill, and was attacked by Warren's brigade of 1,500 men and 36 guns. The gunboats in the river opened upon him and he fell back in disorder, and called for help. Huger led the advance down the Charles City road. In an effort to determine the Union position and to protect his own flanks, his division became scattered, and he devoted the remainder of the day to reconnoitering and an almost harmless artillery duel with Slocum. While this division of 9,000 men frittered away the day, Longstreet and A. P. Hill were maintaining a furious contest.

Longstreet and A. P. Hill moved on the Darbytown road. Longstreet, in advance, at noon, came upon McCall's pickets on the Frazier farm, where he formed line and at 3 P.M., closely supported by A. P. Hill, attacked McCall, forced back his left brigade (Seymour's) after a hard struggle, and captured several guns. Hooker, with Grover's brigade, fell upon the flank of Longstreet's right brigade (Kemper's). Sumner's artillery, covering the opening between McCall and Hooker, opened fire, and Kemper was swept back just as Branch's and Pickett's brigades were advancing to his support. These in turn were checked, but kept up a stubborn fight until nightfall, when they were joined by Pender's and Archer's brigades of Hill's division, and held the ground from which Seymour had been driven. Wilcox's brigade, which had advanced on Pickett's left, captured Randol's and Cooper's batteries after a very obstinate fight, but was forced back by a counter-attack, and Cooper's battery was retaken. Field's brigade, coming to Wilcox's support, forced back Meade's brigade and captured some guns, but Meade rallied and drove it back. Farther on the Confederate left Pryor's and Featherston's brigades, attacked Kearny's left and were several times repulsed. Slocum assisted Kearny with his New Jersey brigade, and Featherston's brigade being thrown into some disorder, Gregg's South Carolina brigade was sent to that part of the field. Late in the day Caldwell's brigade of Richardson's division moved from Franklin's position and reinforced Kearny's left. Two regiments only got into line and fired a volley. The engagement was about over, and darkness came with Kearny's line intact. Only one division, McCall's, had lost any ground during the day, and it lost its commander who was taken prisoner at the close of the engagement, and 14 guns. The Union troops had resisted three separate attacks on flank and rear, and under cover of their splendid fighting, involving great losses on both sides, the immense supply trains and the reserve artillery reached Malvern Hill at four o'clock in the afternoon. During the night the Union army fell back to Malvern Hill. Consult 'Official Records' (Vol. XI); Allan, 'History of the Army of Northern Virginia'; 'McClellan's Own Story'; Webb, 'The Peninsula'; The Century Company's 'Battles and Leaders of the Civil War' (Vol. II).

E. A. Carman.

GLENDIVE, Mont., village and county-seat of Dawson County, on the Yellowstone River and on the Northern Pacific Railroad. It is the centre of a stock-raising and agricultural region and has railroad repair shops. There are deposits of lignite nearby. The village has three hospitals and a poor farm. The electric-lighting and water plants are the property of the village. Pop. 2,428.

GLENDOWER, Owen, Welsh chief, a descendant of Llewellyn and an opponent of Henry IV: b. about, 1359; d. about, 1416. Being wronged by Lord Grey of Ruthin, he rebelled, and assumed the title of Prince of Wales. For over 15 years he maintained an unequal contest, allying himself with the Percies, Ireland, Scotland and France. He captured Grey and Mortimer, but refused to accept pardon from Henry, though his wife and daughter had been made prisoners. Consult Bradley, 'Owen Glyndwr: The Last Struggle for Welsh Independence' (New York 1901).

GLENELG, Charles Grant, Baron, British statesman: b. Kidderpore, India, 1778; d. Cannes 1866. He was educated at Magdalen College, Cambridge, England, and was called to the war in 1807. He entered the House of Commons in 1811, and from 1813 held a succession of portfolios, among them that of Secretary for War and the Colonies (1835–39), on the assumption of which he was created Baron Glenelg.

GLENELG, a river in the province of Victoria, Australia, about 260 miles long. It crosses into South Australia and debouches into Discovery Bay. It is very shallow and during the rainy season is subject to floods.

GLENN, John Mark, director of the Russell Sage Foundation: b. Baltimore, Md., 28 Oct. 1858. In 1879 he was graduated at Washington and Lee University; studied at Johns Hopkins in 1879–80 and in 1882 received the degree of LL.B. from the University of Maryland. In the same year he was admitted to the bar. From 1898 to 1907 he was a member of the supervisors of city charities of Baltimore, acting as president in 1904–07. In 1907 he became general director of the Russell Sage Foundation of $10,000,000 for the betterment of social and living conditions. In 1901 he was president of the National Conference of Charities and Correction.

GLENNON, John Joseph, American Catholic archbishop: b. Kinnegal, Westmeath, Ireland, 14 June 1862. He was educated at Mullingar, and at All Hallows College, Dublin. He was ordained to the priesthood in 1884 and from 1884 to 1887 was assistant pastor of Saint Patrick's, Kansas City, Mo.; from 1887 to 1892 he was pastor of the cathedral there. In 1892–94 he was vicar-general of the diocese and in 1894–95 was administrator. He was appointed coadjutor bishop of Kansas City, with right of succession, and consecrated titular bishop of Pinara, 29 June 1896. On 27 April 1903 he became coadjutor archbishop of Saint Louis and on 13 October following became archbishop. He is the foremost orator among the Catholic hierarchy of America, since the demise of Archbishop Ryan of Philadelphia.

GLENS FALLS, N. Y., city in Warren County on the Hudson River, Glens Falls Feeder to Champlain Canal and the Delaware and Hudson Railroad and Hudson Valley Trolley System (running from Warrensburg to Troy); about 56 miles north from Albany, 50 miles from Troy, 18 miles from Saratoga and 9 miles from Lake George. The river at this point has a descent of about 60 feet with a succession of falls and rapids. Cooper in 'The Last of the Mohicans' has celebrated the falls at this place and the famous cave which lies under the limestone formation at this point. This cave cannot be seen at high water in the spring and fall; at other times it is accessible to any tourist who wishes to visit this quasi-historical spot. Glens Falls is in an agricultural region; in the vicinity of the river are extensive limestone and black marble quarries which have been worked for more than half a century. At the falls are located some of the largest, most extensive, and costly paper mills in the world, as well as various other manufactories. The chief manufactures of the city are paper, pulp, wall paper, Portland cement, lime, lumber, collars, cuffs, shirts, ladies' shirt waists, flour, laths, Joubert & White buckboards, lanterns, machinery and foundry products, ale brewing, brick (ordinary and artificial), paper boxes, cigars, confectionery, gold and silver refining and various minor enterprises. In 1914 there were in operation 82 establishments, employing 2,933 persons, and with a capital of $9,732,000. In the same year salaries and wages to the amount of $1,571,000 were paid. The value of the products was $6,535,000, produced from materials costing $3,541,000. Twelve miles above Glens Falls is situated the great Spier Falls dam across the Hudson, built by the Hudson River Water Power Company, supplying electric light and power along the Hudson and Mohawk valleys as far south as Albany and west to Utica. Glens Falls has several miles of paved streets, a paid fire department, police and all modern municipal equipments. The city owns its own water-works system. Glens Falls has an excellent union school system and its high school building completed in 1906 cost over $120,000. It has also Saint Mary's and Glens Falls academies, Crandall Free Library, Parks' Hospital, Glens Falls Hospital, Glens Falls Home for Aged Women and the Crandall Park. There are many fine buildings, including the home office building of the Glens Falls Insurance Company, the State Armory of Company K, 2d Regiment, N. Y. M., the Ordway Memorial Y. M. C. A. Building, the Village Hall (costing $60,000), and the Empire Theatre Building. There are churches comprising all the leading denominations. Glens Falls has several national banks and a trust company with a combined capital of over half a million dollars. Glens Falls is situated on the Great War Trail leading from Lake George to Albany. Just outside the city limits at the Half-Way Brook was located throughout the French and Indian War and the Revolutionary War a fortified post. A tablet was erected in 1905 by the New York State Historical Association commemorating the two massacres which occurred at that spot during this period, also the encampment there of General Riedesel with Burgoyne's forces while on their way to Saratoga. Glens Falls was settled in 1763; incorporated in 1837 and again in 1874 and 1887. In 1864 the village was practically destroyed by fire. In 1884 and also in 1902 it was visited by disastrous conflagrations entailing a loss of hundreds of thousands of dollars. Pop. 16,362.

GLENWOOD, Iowa, city and county-seat of Mills County, 20 miles from Council Bluffs, on the Chicago, Burlington and Quincy Railroad. The State Institution for Feeble-Minded Children is located here. The chief industries. in addition to corn and live-stock raising, include fruit-growing, farming, granite working and vegetable canning. It has a city hall, court-house, public library, city park and several churches. Pop. 3,291.

GLENWOOD SPRINGS, Colo., city and county-seat of Garfield County, southwest of Denver, on the Denver and Rio Grande and other railroads, and on Grand River. It has several hot springs and is a popular health resort. Cattle-raising, fruit culture and coal-mining are extensively carried on in the surrounding region. Pop. 2,019.

GLIDDON, George Robbins, American archæologist: b. Devonshire, England, 1809; d. Panama, Colombia, 1857. He succeeded his father as United States consul at Alexandria, and was for a long time engaged in archæological researches in Egypt and the Levant. Later he came to the United States and lectured in many cities on Oriental archæology, and was appointed agent for the Honduras Interoceanic Railroad Company. His principal works include 'Appeal to the Antiquaries of Europe on the Destruction of the Monuments of Egypt' (1841); 'Discourses on Egyptian Archæology' (1841); 'Otia Ægyptica' (1849); 'Ancient Egypt'; 'Types of Mankind, or Ethnological Researches Based upon the Ancient Monuments, Paintings, Sculptures and Crania of Races,' etc.

GLINKA, glēn'kä, **Mikhail Ivanovitch**, Russian composer: b. Novospaskoi, 1 June 1803; d. Berlin, 15 Feb. 1857. He came of an aristocratic family and received an education befitting his rank. His musical education was conducted successively by Böhm, Carl Mayer, Field and Dehn. In 1836 his opera 'Life for the Tsar' was presented with success at Saint Petersburg. He was regarded as the founder of Russian national opera and forerunner of Tschaikowsky and was appointed director of the imperial Opera and Kapellmeister to the tsar. A second operatic work, 'Russlan and Ludmilla' (1842), was inferior. His orchestral arrangements of Russian dances became well known in foreign countries. He gave a series of concerts in Paris in 1844 and from 1844 to 1847 he sojourned in Spain and wrote two overtures: 'Jota Aragonesa' and 'Noche en Madrid.' He was a brilliant performer on the pianoforte for which he composed much. He wrote also several orchestral suites and numerous songs. He wrote (in Russian) 'Memoirs and Correspondence with Relatives and Friends.' Consult the study by Fouquè (1880); Cui, 'La musique en Russie' (Paris 1880); Findeisen, N., 'M. I. Glinka' (Saint Petersburg 1898); Pongin, A., 'Essai historique sur la musique en Russie' (Paris 1904).

GLISAN, glĭs'an, **Rodney,** American physician: b. Linganore, Md., 29 Jan. 1827; d. 1890. He was graduated from the medical department of the University of Maryland (Baltimore) in 1849, was assistant surgeon, United States army, in 1850–60, afterward practised medicine in Portland, Ore., and in 1881 was a delegate to the Seventh International Medical Congress. His writings include a 'Journal of Army Life' (1874); 'Two Years in Europe' (1887).

GLOAG, Paton James, Scottish clergyman: b. Perth, 1823; d. 1906. He was educated at Perth Academy and the universities of Edinburgh and Saint Andrews. He became minister at Dunning in 1848, removing to Blantyre in 1860. From 1871 to 1892 he was minister of Galashiels, when he removed to Edinburgh. He is the author of several translations of German works on the Bible and of 'Assurances of Salvation' (1853); 'Exegetical Studies' (1884); 'Introduction to the Johannine Writings' (1891); 'Subjects and Modes of Baptism' (1891); 'Life of Saint John' (1892). Consult biography by his wife (London 1908).

GLOBE, Ariz., city and county-seat of Gila County, north of Tucson, on the Arizona Eastern Railroad. Here is situated the famed Roosevelt Reservoir which cost over $8,000,000. The Old Dominion Library is also a centre of interest. Copper mining and smelting, silver and gold mining are the chief industries. The water supply system is owned by the city. Globe was settled in 1873. Pop. 7,083.

GLOBE, a sphere, a round solid body, generated by the revolution of a semi-circle about its diameter. Globe, or artificial globe, in geography and astronomy, is more particularly used of a sphere made of metal, plaster or pasteboard, on the surface of which is drawn a map or representation of either the heavens or the earth, the former being called a celestial and the latter a terrestial globe. The oldest example of a terrestrial globe known is that constructed at Nuremberg in 1492. One of the earliest to contain both hemispheres is that in the New York Public Library, and is of date 1506–07.

The celestial globe is intended as a representation of the heavens, on which the stars are marked according to their several situations. The terrestrial globe is an artificial representation of the earth, exhibiting its great divisions. The axis of the earth is an imaginary line passing through its centre, and the wire on which the artificial globe turns represents this line. The poles of the earth are the extremities of this axis. The brazen meridian is the circle in which the artificial globe turns, divided into 360 degrees. A degree of a great circle in the heavens is a space nearly equal to twice the apparent diameter of the sun, or to twice that of the moon when considerably elevated above the horizon. A degree on the equator of a terrestrial globe represents 60 geographical miles or 69.2 English miles.

Great circles, such as the equator, ecliptic and the colures, divide the globe into two equal parts; small circles, as the tropics, polar circles, parallels of latitude, etc., divide the globe into two unequal parts. Meridians, or lines of longitude, are semi-circles cutting the equator at right angles. In English maps and globes the first meridian is a great circle supposed to pass through the Royal Observatory at Greenwich. The equator, when referred to the heavens, is called the equinoctial, because when the sun appears in it the days and nights are equal all over the world. The declination of the sun, stars and planets is counted from the equinoctial north and south. The ecliptic is a great circle in which the sun makes his apparent annual progress among the fixed stars; it is the real path of the earth around the sun. The zodiac on the celestial globe is a space which extends about 8 degrees on either side of the ecliptic. Within this belt the motions of the planets are performed. The ecliptic and zodiac are divided into 12 equal parts called signs, each containing 30 degrees; and the sun makes his apparent annual progress through the ecliptic at the rate of nearly a degree in a day. The colures are two great circles of the celestial sphere, one of which passes through the celestial poles and the equinoxes, and the other through the solstices and the celestial poles. The tropics are two smaller circles, each 23° 28′ from the equator, with which they are parallel; the northern is called the tropic of Cancer, the southern the tropic of Capricorn. The polar circles are two small circles parallel to the equinoctial, at the distance of 66° 32′ from it, and 23° 28′ from the poles.

Horizon when applied to the earth is either apparent or real. The sensible or visible horizon is the circle which bounds our view, where the sky appears to touch the earth or sea. It extends only a few miles. The real or true horizon is an imaginary plane passing through the centre of the earth parallel to the sensible horizon. The wooden horizon circumscribing the artificial globe represents the true horizon on the earth; it is divided into several concentric circles arranged in the following order: One containing the 32 points of the compass divided into half and quarter points; another with the 12 signs of the zodiac, with figure and character of each sign; and another having the days of the month answering to each degree of the sun's place in the ecliptic, and the 12 calendar months. The cardinal points of the ecliptic are the equinoctial and the solstitial points, which mark out the four seasons of the year.

The zenith is a point in the heavens exactly overhead and is the superior pole of our horizon. The nadir is a point in the heavens exactly under our feet, being the inferior pole of our horizon, and the zenith or superior pole of the horizon of our antipodes.

The pole of any circle is a point on the surface of the globe 90 degrees distant from every part of the circle. Thus the poles of the world are 90 degrees from every part of the equator; the poles of the ecliptic (on the celestial globe) are 90 degrees from every part of the ecliptic, and 23° 28′ from the poles of the equinoctial. The equinoctial points are in the signs of Aries and Libra, where the ecliptic cuts the equinoctial. The vernal equinox is called the first point of Aries, and the autumnal the first point of Libra. When the sun is in either of these points the days and nights on every part of the globe are equal to each other. The solstitial points are in Cancer and Capricorn. When the sun enters Cancer it is the longest day to all the inhabitants north of the equator, and the shortest day to those on the south side. When the sun enters Capricorn it is the shortest day to those who live in north latitude, and the longest day to those who live in south latitude. The latitude of a place on the terrestrial globe, or its distance from the equator in degrees and minutes, or geographical miles, is reckoned on the brass meridian from the equator toward the pole. The quadrant of altitude is a thin piece of brass divided upward from 0 to 90 degrees, downward from 0 to 18 degrees; when used it is generally screwed to the brass meridian. The upper divisions determine the distances of places on the earth, the distances of the celestial bodies, their latitudes, etc.; and the lower divisions are applied to finding the beginning, the end and duration of twilight. The longitude of a place on the terrestrial globe is the distance of the meridian of that place from the prime meridian, reckoned in degrees and parts of a degree, on the equator. Longitude is either east or west, according as a place is east or west of the prime meridian. No place can have more than 180 degrees, or half the circumference of the globe. Hour circles are the same as meridians. The brass meridian and these circles always correspond.

GLOBE-FISH, or **SEA-HEDGEHOG,** a plectognathous fish of the family *Tetraodontidæ,* examples of which are found on all the warmer coasts of the world, especially within the tropics. Ordinarily they are oval, spinose, small-finned fishes, which nibble the barnacles and crush the small crustaceans and mollusks near shore, with the rodent-like teeth which give them the name «rabbit-fishes» in the West Indies. The moment any danger threatens they suck air or water into a large bladder-like expansion of the abdomen and distend the scaleless skin until they are as round as a ball, all the spines are rigid, and they rise and float at the surface belly upward,— a difficult and disagreeable mouthful; this odd method of self-defense has given them the names «bellows-fish» among English, and «tambor» among Spanish fishermen. Some tropical species are a foot or so in length, but those familiar as «puffers» or «swell-fish» along the coast of the eastern United States are much smaller and serviceable only as comical additions to an aquarium. The flesh of all is poor, and of the hundred species known many are poisonous. The *Tetrodon fahaka* is well known to travelers on the Nile. The two genera are Lagocephalus and Spheroides, the latter containing the familiar northern puffers. Compare DIODON.

GLOBE TAVERN, Battle of. On 17 Aug. 1864 General Grant, then investing Petersburg, directed that Warren's Fifth corps and some cavalry be sent to destroy as much as possible of the Weldon Railroad and make such a demonstration on Lee's right as would force him to withdraw a portion of his troops from the Shenandoah Valley, so that Sheridan might strike a blow at the rest of them. Warren was instructed to move at four o'clock on the morning of the 18th and make a lodgment upon the railroad two miles south of the Vaughan road, and destroy it as far south as possible. A brigade of cavalry under Colonel Spear was attached to his command. Warren moved as directed, drove back Dearing's Confederate cavalry brigade, and took possession of the railroad at Globe Tavern, about three miles south of Petersburg. Griffin's division was formed along the road and began its destruction. Ayres' division moved up the road a mile or more beyond Griffin and Crawford moved up on Ayres' right. About 2 P.M. General Heth, with two brigades, moved out of the Confederate works, made a sudden attack upon Ayres' left and drove it back; Ayres rallied and retook the lost ground The Union loss was 544 killed and wounded and 392 missing. On the morning of the 19th Bragg's brigade was sent to the right of Crawford to support him and establish connection by a skirmish-line with the Ninth corps, and Willcox's and White's divisions of the Ninth corps were ordered to Warren's support. The woods were so dense and the roads so intricate that Bragg failed to establish a proper line, and before it could be connected and completed it was broken. A. P. Hill with Heth's two brigades, Mahone's three brigades, Fitzhugh Lee's cavalry and Pegram's batteries, moved to the Vaughan road intersection. At 4:30 P.M. Mahone, in column of fours, broke through Bragg's skirmish-line, faced to the right, and sweeping forward dispersed Crawford's division and the right of Ayres; at the same time Heth opened on Ayres' centre and left. Warren rallied the broken parts of his line and, advancing, regained the lost ground, taking some prisoners. Willcox's division engaged Colquitt's brigade, drove it back and captured some prisoners; and Mahone's entire command fell back rapidly in great confusion to their entrenchments, «carrying with them the parts of Warren's command disorganized by the attack on their rear in the woods, and a large portion of the pickets.» Heth made repeated attempts to drive Ayres back but failed. Warren's casualties for the day were 382 killed and wounded and 2,518 missing. On the 20th Warren selected a position on the railroad a mile or two in rear of his line of battle of the 19th, chiefly on open ground, and entrenched. On the morning of the 21st A. P. Hill, with his own corps, part of Hoke's division, with Lee's cavalry, attacked his position, opening with 30 guns on his front and right flank, and at 10 o'clock made an assault, which was repulsed. Later Mahone attempted an assault on Warren's left, but the artillery fire broke his ranks before they came under musketry fire, and Warren, making an advance, captured 517 officers and men and six flags. Warren's loss was 301 killed, wounded and missing. No further attempts were made upon Warren's position, and the entrenchments were extended by the Ninth corps from the Jerusalem plank-road to unite with Warren's on the Weldon Railroad. The Union troops engaged 18–21 August numbered about 20,000; the loss was 251 killed, 1,148 wounded and 2,879 captured or missing. The Confederates engaged numbered about 14,800; the number of their killed and wounded is estimated at 1,200. Consult 'Official Records' (Vol. XLII); Humphreys, 'The Virginia Campaign of 1864 and 1865'; Powell, 'The Fifth Army Corps'; Walker, 'The Second Army Corps,' and 'Battles and Leaders of the Civil War' (Vol. IV).

E. A. CARMAN.

GLOBE THEATRE, the theatre in Southwark of which Shakespeare was a shareholder, and in which many of his plays were acted, as were those of Beaumont and Fletcher, Ben Jonson, Wassinger and Ford. The original theatre was built in 1599 on a tract of land between Maiden Lane (now New Park street) by the Burbage brothers, and what was subsequently called Globe Alley; the site is now occupied by Barclay and Perkins brewery. It was octagonal in shape and accommodated 2,000 persons. A patent was granted for this theatre by James I in 1603. It was destroyed by fire in 1613 during the performance of Shakespeare's ‹Henry the Eighth.› The accident was caused by the firing of the thatch roof, a cannon having been discharged during the performance, and the wadding shot from the stage pierced the roof. This was in 1613. The theatre was rebuilt the following year but the new fabric never acquired the fame of the old, and it was destroyed by the Puritans in 1644. In 1644 the structure was demolished to make room for dwelling-houses. According to pictures and descriptions which have survived to the present day the old theatre must have been extremely dingy in the interior and uncomfortable both for the actors and spectators.

GLOBIGERINA, glŏb-i-jĕ-rī'nä, one of the most common of the surface-living or pelagic Foraminifera (q.v.), a shelled protozoan of the class *Rhizopoda.* The animal is like an amœba, exceedingly simple, although throwing out a great number of long, slender thread-like pseudopods, with which it draws in and absorbs minute silicious plants, such as diatoms, etc., which serve as food. Though the animal is so simply organized, the limestone shell which it secretes is composed of several chambers, which are like bubbles, hence the name of the commonest species,— *Globigerina bulloides.* It lives in countless numbers at the surface of the sea, floating on the top of the water, when the sea is calm, with its root-like arms or tentacles (pseudopodia) radiating from the body. The shell, which is of microscopic size, is perforated with fine openings through which the pseudopods pass out. After death the shells, when not dissolved, slowly fall or rain down to the bottom of the ocean, and so light and minute are they that it is calculated that it requires about a month for them to reach the bottom in the deeper parts of the ocean.

GLOBULINS, a term applied to one of the forms of proteids (q.v.) of animal or vegetable origin. The animal globulins are proteids which are insoluble in water, soluble in dilute salt solution and insoluble in saturated solutions of sodium chloride and magnesium sulphate. They are coagulated by heat, the temperature causing the coagulation varying considerably. Fibrinogen, serum globulin of blood; paramyosinogen and myosinogen, of muscle, vitellin, found in eggs, crystallin, in the lens of the eye; and lactoglobulin, in milk plasma, are examples of animal globulins. The plant globulins constitute the most important and abundant natural proteids of plants.

GLOCKENSPIEL, glŏk'ĕn-shpēl', musical instrument first made of a number of bells fastened on an iron rod, one above the other like a pyramid. The bells were struck with a hammer. Later evolutions are in the shape of a lyre with metal bars instead of bells, and metal bars enclosed in a box. The modern nursery toy-piano is a variety of the glockenspiel.

GLOGGNITZ, glŏk'nits, Austria, market town on the Schwarza, 45 miles southwest of Vienna. It has a picturesque castle, which was formerly a monastery, also cotton and woolen mills, quarries, cabinet works and a large paper factory. Pop. 5,296.

GLOMMEN, the largest river of Norway. It rises in Lake Aursundsjö, 2,300 feet above sea-level, flows southerly to the Skager Rack at Fredrikstad, after a total course of 350 miles. The Vormen is its largest tributary. There are several waterfalls which impede navigation but are promising as sources of hydro-electric power.

GLONOIN. See NITROGLYCERIN.

GLORIA IN EXCELSIS, the original form of the Latin hymn ‹Glory be to God on High.› There are four forms of the Gloria, the Greek, the Spanish, the Roman and English. These opening words are taken from the hymn sung by the angels at the Nativity. The origin of this composition is lost in remote antiquity; but was first employed in the Greek Church at Matins. It was introduced into the Roman liturgy by Telesphorus, bishop of Rome, 150 A.D. Pope Symmachus, 500 A.D., is said to have ordered its use at the commencement of the Sunday and holy-day services. The hymn in full is as follows: «Glory be to God on high, peace on earth, to men of good will. We praise thee, we bless thee, we worship thee, we glorify thee, we give thanks to thee for thy great glory, O Lord God, heavenly King, God the Father Almighty. O Lord, the only begotten Son Jesus Christ; O Lord God, Lamb of God, Son of the Father, that takest away the sins of the world, have mercy upon us. Thou that takest away the sins of the world, have mercy upon us. Thou that takest away the sins of the world, receive our prayer. Thou that sittest at the right hand of God the Father, have mercy upon us. For thou only art holy; thou only art the Lord; thou only, O Christ, with the Holy Ghost, art most high in the glory of God the Father. Amen.»

GLORIA PATRI, the first words in their original Latin of the doxology sung or said in the services of almost all Christian Churches. It is employed as a refrain at the end of psalms and canticles as well as at other parts of the service. The complete form of the doxology is as follows: «Glory be to the Father, and to the Son, and to the Holy Ghost. As it was in the beginning, is now, and ever shall be, world without end. Amen.» The doxology is common at the beginning of service in the Greek Church, and was employed at nocturns in the Western or Roman Catholic Church as early as the 6th century.

GLORIETTA, Battle of, an engagement of the American Civil War, fought at Apache Cañon, near Santa Fé, 22 and 28 March 1862. On the first day the contest was indecisive and both sides retired from the field but on the 28th the Confederates were completely routed. Colonel Slough commanded the Federals and Major Pyron the Confederates. Consult Johnson and Buel (eds.), 'Battles and Leaders of the Civil War' (New York 1888).

GLOSS (Gr. «tongue»), the explanation of verbal difficulties in a literary work, written at the passages to which they refer. The words which are commonly the subject of these explanations are those taken without modification from a foreign language, provincialisms, obsolete and technical words, or such as are used by the author in some exceptional signification. The earliest glosses, as those in Greek, Latin and Hebrew manuscripts, were interlinear; they were afterward placed in the margin, and extended finally in some instances to a sort of running commentary on an entire book. In Roman law the word is used also of an explanation, but the explanation is not merely of a word, but deals with the intent of the law. The glosses on the Justinian code, collected by Accursius in the first half of the 13th century, were held almost as high authority as the code. The term is also employed in Biblical criticism for brief readings which, first marginally added to the text for explanatory purposes, have later become part of the text. «Gloss» or «gloze» is also used in an oblique sense to signify a false or disingenuous interpretation.

GLOSSARY. See DICTIONARY.

GLOSSITIS, glŏs-sī'tĭs. Acute glossitis is an inflammatory disease of the tongue due to bites, burns and stings or to tuberculosis or syphilis. It starts in the deeper structure of the tongue, causing it to swell rapidly. The affection is very painful, but is ordinarily cured, if properly treated, in five or six days. Small or large incisions may be necessary. Chronic glossitis is a condition of the tongue, due to persistent use of tobacco, alcohol and spices, in which the surface is reddened, cracked and furrowed.

GLOSSOP, England, market town and borough of Derbyshire, 15 miles southeast of Manchester. It is made up of Old Town, Howard Town and Mill Town. It is an important cotton manufacturing centre and has many cotton, woolen and paper mills, dye works and foundries. The chief buildings are Victoria Hall, a grammar school, mechanic's institute, town hall and market house, hospital, etc. Pop. 22,000.

GLOTTIS, the upper end including the opening of the windpipe, which latter constitutes a narrow aperture covered by the epiglottis during the act of holding the breath or swallowing. The glottis contributes by dilatation and contraction to the modulation of the voice. It is sometimes called the rima glottis, a term more properly limited to the opening of the windpipe. See LARYNX.

GLOTTIS, Œdema of the, a dangerous affection characterized by the effusion of serum in the tissues of the entrance and the inside of the larynx, causing an obstructive swelling. It is due to burns, scalds and the lodgment of foreign bodies; to acute laryngitis or tonsilitis; to tuberculous and cancerous deposits; and to nephritis, measles, diphtheria, scarlet fever and erysipelas. The symptoms which usually develop rapidly are pain, cough, loss of voice and great difficulty of breathing. This difficulty of breathing, unless relieved, may go on to complete suffocation. Incision of the parts may give relief, or tracheotomy or intubation may have to be performed. See NOSE AND THROAT, DISEASES OF.

GLOUCESTER, glŏs'tėr, England, city, municipal and parliamentary borough of Gloucestershire, on the Severn, 114 miles west northwest of London. Public buildings include the cathedral, the 12th century church of Saint Mary, bishop's palace, shire hall, guild hall, prison, public library, technical schools and public baths. It was originally a Roman camp during the Claudian invasion, and fragments of the walls still remain. Shipbuilding, railway coach and wagon works, brass and iron foundries, flour and saw mills, roperies and potteries, are the leading industries. An abbey built by Osric in 681 was refounded in 821 for secular clergy, and in 1022 these gave place to Benedictines, introduced by Canute. In the cathedral are the tomb of Edward II, the monument of Osric, the effigy in Irish oak of Robert, Duke of Normandy, and a modern monument by Floxman. Some of the stained-glass windows are of singular beauty. The episcopal see was founded by Henry VIII in 1541 and in 1836 united with that of Bristol. A monument in the precincts of the cathedral marks the spot where Bishop Hooper was burned. In the civil war the city was unsuccessfully besieged by the Royalists. Triennial musical festivals are held at Gloucester. Pop. 46,000. Consult Masse, 'Victoria History of the Counties of England' (London 1907).

GLOUCESTER, Mass., city and port of entry of Essex County, near the extremity of Cape Ann, and on the Boston and Maine Railroad, 32 miles northeast of Boston. It is a popular summer resort and contains the Gilbert Hospital, Home for Aged Fishermen, Huntress Home, the Magnolia, Sawyer and public free libraries and several parks. It is one of the most important fishing ports and fish markets in the world, having over 500 vessels and 6,000 men engaged in the fisheries. Cod, haddock, halibut, herring and mackerel are the principal catches. Besides extensive fisheries, the city has large manufactures of machinery, hardware, hosiery, nets, sails, fish-glue, oil, shoes, twine and cigars. Shipbuilding and brass founding and granite quarrying are also important industries. In 1914 87 establishments were in operation, with invested capital of $7,110,000, giving employment to 3,274 persons, and paying in salaries and wages $1,801,000. The materials used were valued at $5,590,000 and were turned into finished products valued at $8,834,000. Numerous vessels have been wrecked in the vicinity of Gloucester. A massive rock called Norman's Woe was the inspiration for Longfellow's famous poem, 'The Wreck of the Hesperus.' The city was founded in 1623, principally by settlers from Gloucester, England, from which it received its name; was incorporated as a town in 1642; and became a city in 1874. The city adopted the commission form of government in 1908. The waterworks are operated by the city. It has the oldest Universalist church in the United States, founded in 1770. Pop. 24,398. Consult Babson, J. J., 'History of Gloucester' (Gloucester 1860, supp. 1876); Pringle, J. R., 'History of the Town and City of Gloucester, 1623–1902' (ib., n.d.).

GLOUCESTER CITY, N. J., city in Camden County, on the Delaware River and on the Atlantic City and the West Jersey and Seashore railroads. The manufactures include calico prints, woolen yarns, gas burners, Smyrna rugs, drills, paper and boats. In 1914 there were 23 establishments in operation, capitalized at $6,110,000, and giving employment to 2,100 persons. Salaries and wages were paid to the amount of $959,000, and materials valued at $3,213,000 were turned into products worth $4,711,000. The city was incorporated in 1868, and is governed by a mayor chosen every two years, and by a unicameral council. It has ferry connections with Philadelphia, and has electric lights and street railroads. It was settled in 1677, incorporated in 1868 and is governed by a mayor, chosen biennially, and a council. The waterworks are the property of the municipality. Pop. 10,577.

GLOUCESTERSHIRE, England, maritime county in the west of England, at the head of the Severn estuary. Its area is 1,259 square miles, comprising three natural divisions — the Hill or Cotswold, the Vale and the Forest. The principal rivers are the Severn, Upper and Lower Avon, Wye and Thames. The orchards are extensive and the county is noted for its excellent butter and cheese. The Forest of Dean and the Bristol coal fields produce millions of tons of coal annually. Other minerals are iron, limestone, sandstone, ochre and strontium sulphate. Of manufactures the most important is that of woolens, including fine broadcloths; others are silk, gloves, glass, pottery, etc. Pop. 736,000. Consult Ditchfield, 'Memorials of Old Gloucestershire' (London 1911).

GLOUSTER, Ohio, village in Athens County, 15 miles north of Athens, on the Kanawha and Michigan, the Toledo and Ohio Central and other railroads. Brickmaking and coal-mining are its principal industries. The village owns the waterworks and electric-lighting plant. Pop. 2,527.

GLOVE, a covering for the hand either for warmth or protection, or for dress. Its use dates back to remote antiquity. Laertes, the farmer-king, wore gloves to protect his hands from the thorns. Xenophon sneered at the Persians for wearing gloves to keep their hands warm. In their more robust days the Greeks and Romans scorned the use of gloves; but in later times they were used in Rome. The glove appears to have become a well-known article of dress in England about the 14th century, and corporations of gloves were in existence in the 15th century. In the days of Queen Elizabeth gloves were made with gauntlets upon which much rich and elaborate embroidery was worked.

Modern gloves are of two distinct classes, woven and knitted gloves, and those made of leather; and the making of these constitute entirely separate branches of manufacture. The manufacture of knitted or woven gloves is an industry allied to the hosiery trade, and the materials comprise all the ordinary fibres, the most important being silk and wool. In some cases these gloves are entirely made and finished by knitting; but in others, the pieces are separately fashioned and sewed together as in making leather gloves. The manufacture is widespread, but the headquarters of the thread and cloth glove trade are now Berlin and Saxony. The materials used for making leather gloves are principally the skin of deer, sheep and lambs, goats and kids, the latter being the most important, though far more "kid" gloves are made of sheep than of kid leather. The skins for military and other heavy gloves —doe or buck leather — are prepared by the ordinary process of tanning, or are a fine kind of chamois leather. Those for what are called dressed kid gloves are subjected to a special method of tanning, by which, under the influence of heat, and treatment with a mixture of flour, yellow of egg and alum, the material is rendered peculiarly soft and flexible. After the leather has been properly prepared it is cut into pieces of the required size, then folded over somewhat unequally, as the back should be larger than the front. Three cuts are then made through the doubled piece to produce the four fingers; an oblong hole is cut at the bending of the fold for the insertion of the thumb piece; the cutting of this of the exact shape and size is usually done with dies. The first and fourth fingers are completed by gussets or strips sewed only on their inner sides, while the second and third fingers require gussets on each side to complete them. Besides these, small pieces of a diamond shape are sewed in at the base of the fingers toward the palm of the hand.

A kind of vice or clamp, with minute teeth to regulate the stitches, is used in the making of hand-sewn gloves, by which method all the finest gloves are stitched. Sewing-machines are applied for the ornamental or embroidery stitching on the backs of fine gloves, and for almost the entire sewing of the cheaper and heavier gloves. The superiority of the French and the best English gloves depends chiefly on the adaptation of their shape to the structure of the hand by giving additional size where the flexure of the hand requires it.

Kid gloves are of two principal kinds, glacé and suède, according to the manner of dressing and finishing the leather used. Glacé gloves are those which are dressed, dyed and polished on the hair or outer side of the skin, while suède gloves are carefully pared, smoothed and dyed on the inner side of the skin for their purpose, and thus have the appearance of fine chamois. Paris and Grenoble are the chief seats of the French kid glove trade. Military gloves are made at Niort and Vendôme. Brussels and Copenhagen are also important glove-making centres. In England, Worcester is the principal seat of the glove industry; and in a specialty, the so-called English dogskin gloves made from tan skins of Cape sheep, the English manufacturers are without rivals. Rubber gloves are now made in both Europe and America and are largely used in operations demanding careful asepsis, particularly when the surgeon is forced to operate on a clean case after a septic wound. Gloves with roughened surfaces are made to facilitate the handling of instruments and ligatures. See GLOVE MANUFACTURE IN AMERICA.

Production.— The United States census of manufactures for 1914 recorded 352 establishments in the United States engaged in the manufacture of leather gloves. The output for that year, including gloves, mittens and gauntlets, numbered 3,082,376 dozen pairs, valued at $20,296,558. As compared with the figures for 1909 the number of factories in this trade has decreased by 6.6 per cent, the output by 8.5 per cent, and the value by 9.9 per cent. Of the total production, men's gloves were in much the largest proportion, amounting to 2,367,263 dozen pairs. Of women's and children's gloves there were made 425,501 pairs; and of boys' gloves, 289,612 dozen pairs. Of the 352 establishments reported, 216 were located in New York, 28 in Illinois, 24 each in California and Wisconsin, 8 in Iowa, 7 in Pennsylvania, 6 each in Ohio and Washington, 5 each in Massachusetts and Minnesota, 4 in Indiana, 3 each in Michigan, New Hampshire and Virginia, 2 each in Colorado, Connecticut, Maryland and Missouri and 1 each in New Jersey and Oregon.

Knitted gloves and mittens are made in the hosiery mills of the country. The production in 1914 was 2,470,183 dozen pairs, valued at $10,519,613.

GLOVE MANUFACTURE IN AMERICA dates from about the year 1760, when Sir William Johnson, chief agent of King George with the North American Indians, brought over from Scotland several families from Perthshire, which settled in the eastern part of what is now Fulton County, N. Y., calling the town Perth. Many of these settlers had been glove-makers and members of the glove guild in Scotland, and brought with them glove patterns and the proper needles and threads for glove making. The first gloves and mittens were used chiefly by the farmers and wood choppers as a protection for the hands while engaged in the rough and laborious work incident to their occupation. The entire output of the industry for many years was probably disposed of in the immediate vicinity. It was not until about 1809 that gloves were manufactured for more distant markets, and it is stated that Talmadge Edwards, a storekeeper of Johnstown, N. Y., was the pioneer in the manufacture of gloves in commercial quantities. Mr. Edwards took a bag of them on horseback to Albany when making a trip for the purpose of renewing his stock of merchandise. Finding a good demand for these articles, he had leather dressed in quantities, and secured farmers' girls to come to his factory to cut gloves, which were then sent out to farmers' wives to be sewed. In this manner the glove and mitten industry of the United States was established. During the incipient stages of this industry the goods produced were really mittens, and not gloves. A glove, as distinguished from a mitten, is a covering for the hand in which each finger is separately enclosed, the part above the hand varying in length according to fashion or convenience. About the year 1810 a glove manufacturer, who had been associated with Mr. Edwards, sold a part of his output by the dozen, and this is said to be the first instance in which they were sold by the quantity. The local demand continued to increase, and each year some enterprising manufacturer would venture to make an extended trip to dispose of his product. In 1825 Elisha Johnson, of Gloversville, N. Y., went to Boston with a load of gloves in a lumber wagon, making the journey in six weeks. This is said to have been the longest trip that had been made in connection with the industry up to that time, and the results were highly gratifying to those interested.

Until 1862 the manufacture of gloves in Fulton County, N. Y., although even then the chief manufacturing industry, was of comparatively small importance. The stimulating influence of a high protective tariff in 1862 showed itself in the increased business at Gloversville, Johnstown and the adjoining village of Kingsborough, which became at once the leading sources of supply for the home market of gloves of medium grade. While the protective tariff stimulated home industry in one direction, it limited it in another. The domestic materials that could be used in glove making were confined practically to deer, lamb and sheep skins. The peculiar qualities of the first established it firmly and independently of any tariff, but the others, being inferior in quality to skins of foreign production, could not effectually exclude foreign made gloves, but were forced to share the market with them. Still, the demand for cheap and medium gloves was limited, and the American manufacturers saw their development arrested, while France, Germany and England continued to supply all the finer grade of gloves used in this country. In 1872 the tariff on imported skins was removed amid intense opposition and doleful prediction of ruin to the home industry. A large number of skins came from all parts of the world, and the glovers turned their attention to tanning. Instantly experimenting began, and skill in tanning rapidly increased, so that the highest grade was attained, and to-day the various kinds of leather produced in Fulton County are unsurpassed in quality by that furnished in any other part of the world.

The introduction of free hides made American glove manufacturers far more prosperous than they had ever been previously. The quality of the product has steadily improved, and the variety has been increased until now American made gloves are steadily driving out the foreign gloves. The skill of American glovers is equal to that of foreign glove-makers, and in some respects — notably in the quality and style of the stitching, and in some grades, the shape — the American gloves are the best. The American glovers are more enterprising, and their styles are of a greater and better variety than foreign made gloves. Foreign expert workmen have been drawn over here from the great glove centres in Europe, so that the greatest skill has been secured here. The approximate value of the glove industry in Fulton County has reached about $10,000,000. Some of the firms do a business reaching as high as $1,000,000, but the majority, however, have small shops and do a small but profitable business.

Most of the work in Fulton County, as abroad, is done at the homes of the workers. The streets in Gloversville and Johnstown are lined with pretty and tasteful homes, in which the hum of the sewing-machine is constantly heard during the working hours of the day, but the workers are exceptionally fortunate in being able while earning good wages to enjoy all the comforts and surroundings of home, and in being practically their own masters and mistresses. In these homes are installed more than 1,500 electric motors, some dwellings having two.

Electric power adds 30 per cent to the weekly earnings of the operator. The factories are open from 7 A.M. to 6 P.M., but most of the work is piecework, at which each worker is expected to spend not less than seven and one-half hours per day. The delicate operations require a high degree of skill which is well paid for.

When the skins are received at the factory they are thoroughly soaked to open out the texture and prepare them for the removal of the hair. Then the skins are placed in vats of lime water, where for two or three weeks the lime works into the flesh and albuminous matter, and loosens the hair. The skins having thus been properly softened, the dirty but picturesque operation of removing the hair ensues. Before each beamer, as the workman is called, is an inclined semi-cylindrical slab of wood, covered with zinc. The skin is first spread upon this, and the broad curved beam of the knife glides across it from end to end, scraping and removing all the loosened hair, the scarf skin, and the small portion of animal matter still adhering to the skin. After unhairing, kid skins must be fermented in a drench of bran; the purpose is to completely decompose the remaining albuminous matter, and also to remove all traces of the lime. The operation is extremely delicate.

With the preparation of kid leather, alum is the astringent curative agent. Its operation is accompanied by that of others; the purpose is to secure elasticity, and pliability, and mainly to preserve that beautiful texture which makes kid leather superior to all others. The assistants in the process are eggs, flour and salt. They are combined into what is called a custard, and there is certainly nothing repulsive in the idea of such a delicate agent being used. A proper quantity of the custard and a number of skins having been put together in a dash-wheel, where they are thrown about for some time, opens the pores of the skins, aborbs the custard freely and becomes swelled by the chemical union of the custard and the skin. This having progressed satisfactorily, the skins are folded together with the fleshy side outward, and are dried by a gentle heat. They are now cured, but they are yet hard and rough. The breaking and "staking," as they are called, are now resorted to to make the skins soft, pliable and of even texture, removing the superfluous chemicals with which they have become charged, and the stiffness by manipulating the fibres. The operation of transforming the skin into leather is now finished, but age is necessary to secure perfect pliability and softness. The skins are therefore laid away to let the slow chemical operation going on within them be completed. After this has been accomplished the skins are ready for dyeing, cutting and manufacturing.

Calf skins as well as horsehides are used in the manufacture of workingmen's gloves. They are tanned in two ways, namely, oil tan, with a preparation that makes them what is called "fire and water proof," and they are also dressed and have the same finish as the buck glove.

In the dye-rooms the skins which have already been aged are immersed in dye vats, where the delicate colors are imparted to them. The same care is not required in obtaining the ordinary range of dark colors, for these are "brushed" on, the skin being spread upon a glass slab and the dye being painted on with a brush. After they are dyed the skins are sometimes somewhat hard, and some classes have to be staked again in order to restore their pliability. The finishing touches to a kid skin are secured by rubbing the grain side over with a "size," which imparts a gloss. The experience of Gloversville manufacturers with buck gloves has enabled them to impart a special finish to a skin the same as the suède finish, which is very popular under the title of "mocha." This is the same as suède finish, which is produced in other countries by shaving off the grain side of the skin at an early stage of its progress. The Gloversville method is much better, however, and has more perfect results. Here the grain is removed, and the velvet finish secured by buffing the surface on an emery wheel. The surface of the leather is cut away in minute particles by this process, and the result is an exceedingly even and velvety texture, superior to that obtained by other methods.

The concluding work is as follows: A marble slab lies before the cutter on a table and every particle of dirt or other inequality is removed before "doling." The skin is spread, flesh side up, upon the slab, and the cutter goes over it with a broad-bladed chisel or knife, shaving down inequalities and removing all the fibrous portions. The dexterity with which this is done makes the operation appear extremely simple, but any but a skilled and experienced operative would almost surely cut through the skin. The most delicate part of the glovemaker's art, in which exact judgment is required, comes in preparing the "tranks" or slips from which the separate gloves are cut. The trank must be so cut as to have just enough leather to make a glove of a certain size and number. The operation would be easy enough if the material were hard and stiff, and if the elasticity were uniform, but this is rarely the case.

The gussets, facings, etc., are cut from the waste leather in the thumb opening at the same operation. In olden times an outline was traced upon the leather and the pattern was cut with shears. Modern invention has produced dies and presses which are universally used. Similar dies are used in the cutting of the thumb pieces and forchettes or strips forming the sides of the fingers.

Gloves are proportioned by a scale based on the fact that in the average man's hand the length of the third finger is the same as the width of the hand, and the same figure is the length of the body of the hand to the wrist. It is customary to make the ordinary short glove one-fourth longer than the body. Ladies' gloves are made slimmer in the body of the hand and with relatively longer fingers. The large factories commonly turn out a product comprising 30 distinct sizes.

The gloves are somewhat unsightly as they come from the sewer's hands, and must be made trim and neat. To secure these desirable results the gloves are taken to the "laying-off" room. In this are long tables with a long row of brass hands projecting at an acute angle. These are filled with steam and are too hot to touch, but by ingenious devices they are so arranged that it is impossible to burn the glove or stiffen the leather by too much heat, a common defect in ordinary methods. The operation of the «laying-off room» is finished with surprising quickness. Before each table stands an operator, who slips a glove over each form, draws it down to shape, and after a moment's exposure to the warmth removes it, smooth, shapely and ready for the box.

About 25 years ago a skin called «mocha» was utilized, and has been ever since, in making fine gloves, and they are finished similar to the suède finish, giving them a very velvety appearance. They are very soft and pliable, and in fact have been almost as popular as the fine kid and lamb gloves. These mocha skins are all gathered in Arabia, from the peculiar haired sheep of that country. They received their name from the fact that the first in this country came with an invoice of mocha coffee.

The special census of manufactures taken for the United States in 1914 shows that in that year there were 352 establishments of factory grade in the country, making leather gloves and mittens. Of the entire number 216 are in New York State, 24 in Wisconsin and 28 in Illinois. The others are scattering. The number of persons occupied in this industry was 12,345, of whom 10,668 were wage-earners receiving a total of $4,558,360 annually in wages. The capital employed in this factory production aggregated $17,080,398, and the value of the finished product was $21,614,109: of this, $9,-443,415 had been added by the processes of manufacture.

These figures include some but not all of the home workers; and it is to be noted that the number of factory wage-earners in 1914 is nearly 3,500 less than the number registered (14,180) in the census of 1900. The remarkable growth of the industry is seen by comparing the above figures with those of the census of 1850. At that time there were 110 establishments of all grades making leather gloves and mittens in the United States. They employed an aggregate of 1,938 hands, and their annual output was valued at $708,000.

Previous to the outbreak of the war the imports of leather gloves and mittens from France amounted to about $3,000,000 a year, and from Germany about $2,000,000 a year. Of fabric and knitted gloves nearly the whole supply came from Germany. The difficulties in the way of imports had a great stimulative effect upon the glove manufacturing industry of America. When the war began the stock of skins suitable for glove making in the country was about enough to last the factories four months. Notwithstanding all efforts to replenish the stock the scarcity increased and the price rose, the result being that many of the factories making leather gloves took up the manufacture of fabric gloves.

The fabric used in this branch of the industry is not an ordinary woven cloth, but is made with a combination stitch of which the loop used in knitting forms a part, yielding an elastic fabric which does not unravel when cut in any direction. The fabric is cut with pattern knives or dies just as with leather gloves, and the process of making is generally the same. Fabric gloves when the sewing is completed are in size fit for a giant. They are shrunk to the proper size, and this process thickens up the fabric to a certain richness and fullness of texture peculiar to fine gloves. The materials out of which these gloves are made, in the order of their value, are Angora, Cashmere, Alpaca and Camels' Hair yarns. The so-called «seamless» gloves are not cut out and sewed as with fabric gloves, but are knitted from fine wool threads on knitting machines. Some of the larger concerns buy their raw material in the wool and spin their own yarns as well as dye them.

Knitted gloves of the ordinary type are made with the plain knitted loop, or in the rib and tuck stitches. The hand portion is laid out on a flat frame nine inches wide with 12 needles to the inch. The cuff is first knitted, then the flat of the hand, leaving out the opening for the thumb. When the fingers are reached, two strips are knit for each finger but the first, which is knit in one piece in the centre of the width, the two pieces for the fourth finger being on the extreme right and left sides of the width. The knitting being completed, the glove is taken from the machine and folded together on itself, along the centre line of the first finger strip, and the parts are sewed together along the edges of the finger pieces and along the outside of the hand. The thumb is knitted separately and sewed into place. When finished the glove is subjected to a shrinking process which thickens it up and makes it much warmer to wear. Mittens are of simpler manufacture, there being but the one seam to sew over the top and down the outside of the hand.

The imports of gloves from all countries in the fiscal year ended 30 June 1916 amounted to $4,798,943 of which three-fourths came from France and a value of $130,000 from Germany.

Benj. Lichtenberg,
Of J. Adler and Company, New York.

GLOVE SPONGE, a poor variety of commercial sponge found about the Bermudas and in the Gulf of Mexico, which has a branching growth likened to the fingers of a hand or glove.

GLOVER, Elizabeth. See Bennett, Mary E.

GLOVER, John, American soldier: b. Salem, Mass., 1732; d. Marblehead, Mass., 1797. A shoemaker, and later a fisher at Marblehead, he was elected (1773) colonel of a militia regiment, known in the Revolution as the Fourteenth, or the «Marine» regiment. In 1775 he, with Stephen Moylan, was appointed director of the manning and equipment of vessels, in 1776 after the Continental defeat at Long Island superintended the transportation of the army to New York, and also directed the crossing of the Delaware previous to the battle of Trenton. Commissioned brigadier-general in 1777, he participated in Sullivan's Rhode Island expedition (1778), was a member of the court that tried André and was retired in 1782. He sat in the Massachusetts convention that ratified the Constitution in 1788. A bronze statue of Glover stands in Commonwealth avenue, Boston.

GLOVER, Richard, English poet: b. London, 1712; d. there, 25 Nov. 1785. In 1737 he published the epic poem of 'Leonidas,' which abounds in noble sentiments, considerably varied by incident and description, but lacking in interest, and not sufficiently imaginative for lasting popularity. The 'Progress of Commerce' followed in 1739, one of the objects of which was to rouse a spirit of national hostility against the Spaniards and the ministry — a purpose which was much more effectually answered by his celebrated ballad of 'Hosier's Ghost.' In 1753 his tragedy of 'Boadicea' was performed with partial success. His 'Medea' imitated from Euripides and Seneca, in 1761, obtained greater attention.

GLOVER, Stephen, English composer: b. London, 1812; d. Bayswater, London, 7 Dec. 1870. He wrote nearly 1,500 compositions, including works for pianoforte, vocal duets, ballads and songs, many of a sacred character, such as the 12 'Songs from the Holy Scriptures.' Among his published music are 'The Monks of Old'; 'The Gypsy Countess'; 'What are the Wild Waves Saying?' and a setting for Longfellow's 'Excelsior.'

GLOVER, William Howard, English composer: b. Kilburn, London, 6 June 1819: d. New York, 28 Oct. 1875. For several years he was musical critic of the London *Morning Post,* and in 1868 became conductor of Niblo's orchestra and a teacher in New York. His writings include the opera 'Ruy Blas' (Covent Garden 1861); a cantata, 'Tam o' Shanter,' first presented at the New Philharmonic in 1855 with Berlioz as conductor; and the overtures 'Manfred' and 'Comala.'

GLOVERSVILLE, N. Y., city in Fulton County, on the Fonda, Johnstown and Gloversville Railroad, 53 miles northwest of Albany. This is the most celebrated glove manufacturing centre in the world, producing over two-thirds of the entire glove output of the United States. Here are the Nathan Littauer Hospital, the Parsons Free Library, the Carnegie library, Federal building and other public institutions. Besides numerous large manufactories for gloves, gauntlets and mittens, there are other factories of leather goods. There were in operation, in 1914, 211 establishments with a combined capital of $11,898,000, employing 6,240 persons, and paying $3,341,000 in salaries and wages. Materials to the value of $7,865,000 were turned into products worth $13,384,000. It was incorporated as a village in 1851, although it was settled before the Revolution, being known as Stump City. It was chartered as a city in 1890. The municipal government under the revised charter of 1899 is administered by a mayor, who is elected by the people every two years, and a common council, elected for a like period. The members of the board of education and the water commissioners are also chosen by popular vote. The municipality owns and operates the waterworks and sewage system. Pop. (1910) 20,642; (1914) 21,618.

GLOW-WORM. See FIRE-FLY.

GLOXINIA, glŏk-sĭn'ĭ-ạ, a small genus of plants of the family *Gesneriaceæ,* distinguished by the somewhat bell-shaped corolla, the upper lip being shortest and two-lobed, the lower three-lobed, with the middle lobe largest, and also by the summit of the style being rounded and hollowed. The species are natives of tropical South America. The plants cultivated in hothouses under the name of Gloxinia belong to the closely related genus *Sinningia,* and are natives of Brazil. They are now among the greatest ornaments of hothouses owing to their handsome leaves and their graceful, beautifully colored flowers, which have been greatly improved by cultivation. The chief species is *S. speciosa,* with large violet flowers from which many fine varieties have been derived, usually associated under the specific name *Gloxinia hybrida.*

GLUCINA, the oxide of glucinum (q.v.).

GLUCINUM, gloo-sī'nŭm, or **BERYLLIUM,** a metallic element which occurs in the minerals beryl, chrysoberyl, phenacite and euclase. The name "beryllium" was assigned to it on account of its occurrence in the beryl, and the name "glucinum" on account of the sweetish taste of its salts. Its chemical symbol is sometimes taken as Be, and sometimes as Gl. Glucinum is a dyad with an atomic weight of about 9.08, and a specific gravity (when compressed) of about 1.93. It melts at about 2550° F. It resembles steel in general appearance, and forms hard, hexagonal crystals which are unaffected by air at ordinary temperatures, and which are scarcely affected by oxygen or sulphur, even at a red heat, though when heated in chlorine the metal burns to the chloride, $GlCl_2$. It dissolves readily in hydrochloric acid. Sulphuric acid and caustic potash or soda also dissolve it, but nitric acid, even when hot, and concentrated, acts upon it very slowly. The specific heat of metallic glucinum is about 0.400 at ordinary temperatures but it increases rapidly as the temperature rises, and is about 0.58 at 500° F. The oxide of the metal, known as "glucina," GlO, was first ascertained to be a new earth by Vauquelin, who in 1798 obtained it from beryl, and pointed out that it differs from alumina in several important ways, notably in the fact that it does not form an alum. Metallic glucinum was first prepared by Wöhler in 1828, by the action of metallic potassium upon fused $BeCl_2$. Glucinum forms many salts, but the metal and its compounds are of interest only to the chemist, as they are not used for any purpose in ordinary life. It seems, however, to endow a relatively large quantity of copper with valuable properties.

GLUCK, glŏk, **Alma** (REBA FIERSON), American soprano singer: b. Bucharest, Rumania, 1886. She came to America in 1889; was educated in the public schools, Normal College, New York, and Union College, Schenectady, N. Y. She studied music under Signor Buzzi-Peccia, New York. She made her New York début in 'Werther' in 1909, and during the ensuing season sang 11 different rôles only two of which she had previously studied. She is noteworthy as one who gained recognition in opera and on the concert stage without European training. In 1914 she married Efrem Zimbalist.

GLUCK, Christoph Willibald, RITTER VON, German composer: b. Weidenwang, in the upper Palatinate, 2 July 1714; d. Vienna, 15 Nov. 1787. After studying six years at the Jesuit school at Komotow, where his musical talents were especially encouraged, he supported himself for a time by giving music lessons. Later he attracted the notice of Prince Lobkowitz, who enabled him to complete his musical education at Vienna. At 26 he was desired to write an opera for the court theatre at Milan and the result was his 'Artaserse,' which achieved a great success in spite of many innovations in composition introduced into the work. In 1742 he wrote 'Demofoonte' for Milan; 'Demetrio ed

Ipermnestra' for Venice; in 1743 'Artamene' for Cremona, and 'Siface' for Milan; in 1744 'Fedra' for the same theatre; and in 1745 'Allessandro nell' Indie' for Turin. His fame had now become European and he went to England to compose for the theatre in the Haymarket. On 7 Jan. 1746 that theatre was opened with 'La Caduta de Giganti.' In London Gluck became deeply impressed with the majestic character of Handel's airs and choruses, and with the simple but natural dramatic style of Arne. Leaving London in 1746 he continued opera composition, among his later works being 'Clemenza di Tito'; 'Le Cinese'; 'Il Trionfo di Camillo'; 'Antigone'; 'La Danza'; and 'Orfeo ed Euridice' (1762), his greatest work up to that time, and still a favorite in Germany after nearly a century and a half. It was followed by 'Alceste' (1767); and 'Paride ed Elena' (1769). In 1774 his 'Iphigénie en Aulide' was produced in Paris after a considerable amount of opposition from the musical critics of the old Italian and French school, at that time represented in Paris by Piccini. The most intense excitement prevailed; all Paris took sides, and for a long time the Gluckists and Piccinists contended with the same bitterness as did formerly the Jansenists and Jesuits, and in our own day Wagner and his opponents. The victory remained with the Gluckists. Shortly after the production of the 'Iphigénie,' the 'Orfeo' was adapted for and put on the French stage, and was followed by the 'Armide' in 1777, and by the 'Iphigenie en Tauride' in 1779, his last important work, and by many considered his greatest. It ends the series of works which directed the operatic genius of Méhul and Cherubini in France, and of Mozart, Beethoven and Wagner in Germany. Consult 'Lives' by Marx (1863), Desnoiresterres (1872), Reissmann (1882); d'Undine (1906); Tiersot (1910).

GLÜCKSTADT, glük'stät, Prussia, town of the province of Schleswig-Holstein, on the Elbe, 31 miles from Hamburg and 28 miles northwest of Altona. It has a fine town hall, a gymnasium, a provincial prison and a penitentiary. Commerce and fishing constitute the chief employments of the people. The city has railroad repair shops, shipyards, furniture, wagon, shoe, soap, cigar, brick factories, etc. It was founded in 1617 by Christian IV of Denmark, who fortified it. In 1815 its fortifications were destroyed. It receives considerable shipping at periods when Hamburg is congested. Pop. 6,500.

GLUCOSE, glū'kōs (from Gr. γλυκύς, sweet), in the commercial sense, a very thick syrupy liquid obtained by the partial hydrolyzing of starch, sometimes called «cereal syrup»; when in solid state, known as grape-sugar or «cereal sugar.» In Europe it is chiefly made from potato starch, but in the United States it is made almost exclusively from corn; whence its popular name «corn syrup.» In color it ranges from water white to brownish, usually a light amber. It is sweet to the taste but has no distinct flavor. Nature's process of changing the starch stored in the cells of plants into different forms of sugar was early recognized. In the case of cane-sugar (sucrose) it was known that the plant absorbs carbonic acid from the air; other acids from the soil; and by the aid of the sun's heat a chemical process is evolved that puts into the sugar-plant sucrose or cane-sugar, and into fruits and vegetables fruit-sugar which is found more plentifully in the grape than in any other fruit.

The chemist has endeavored to obtain sugar from starch by a somewhat analogous process, and one similar to that carried on in the human system during the process of digestion, when starch is changed into sugar. Cane-sugar and fruit-sugar as they exist in cane and fruits are natural products, but whether nature's order of combining the various articles composing fruit-sugar as found in fruits is the same as the order of combination followed by the chemist in making sugar from starch is a debatable question. Some claim that while the glucose of fruits and glucose as obtained by the chemist may be identical so far as their constituent elements are concerned and the proportion of each which is present, it does not follow that they are the same thing, or that their dietetic value is equal. Neither does it follow that because the chemical composition of true glucose (dextrose) is almost identical with that of cane-sugar (sucrose) its food value is quite as evenly matched.

Nature and Chemist.— In the laboratory of nature the starch or gum ($C_6H_{10}O_5$) which is formed in the plant is treated by carbonic acid taken from the air, and by other acids absorbed from the soil and carried into the plant by the sap, and through the action of light and heat is changed into cane-sugar (sucrose) $C_{12}H_{22}O_{11}$.

Art or chemistry takes starch from corn (maize), treats it with hydrochloric or other acid (which is afterward neutralized or removed by alkali), the resultant product being glucose $C_6H_{12}O_6$, differing in its constituent elements from cane-sugar in that it contains one more equivalent of water. If to $C_{12}H_{22}O_{11}$ (cane-sugar) is added H_2O, it is equal to twice $C_6H_{12}O_6$ or glucose $C_{12}H_{24}O_{12}$. «It remains,» said a prominent manufacturer of glucose, «for some one to discover means for eliminating from glucose the one equivalent of water; and, that found, chemistry can make from starch an article the chemical formula for which is exactly like cane-sugar. And somebody will some day stumble over the method.»

History of Glucose.— It was in 1792 that Lowitz announced that there was other than cane-sugar, he having obtained dextrose, a different variety, from grapes. In 1811 Kirchhof, in Russia, in the attempt to find a substitute for gum arabic, obtained dextrose from starch by the action thereon of dilute sulphuric acid. By similar process Braconnot, in 1819, obtained it from linen rags, sawdust or other vegetable fibre. During the reign of Napoleon Bonaparte starch-sugar was made to make good the deficiency which the continental blockade caused in the supply of cane-sugar. Early in the 19th century it was made from potato-starch in Germany, and during the latter half in France. From 1825 to the present time the chemists of France, Germany and the United States have studied to improve processes, but nowhere in the world is glucose made so perfectly and at so low a cost as in the United States, where raw material is cheap, and the processes of manufacture so perfected that this country is fast meeting the European demand for glucose and causing the industry to dwindle in continental Europe. This country can manufacture glucose, send it to Europe, pay a 30 per cent tariff and then undersell the makers of Europe, the proof of which is the statement which follows showing the exports of glucose from the United States. From 1838 the number of factories in France and Germany increased until 40 years later there were 85, and in the Austrian Empire, where the industry began about 1840 or a few years earlier, over 100. In 1889 Germany had 30 glucose factories which produced 34,684,100 kilos glucose syrup and 2,748,000 kilos couleur.

The manufacture of glucose or grape-sugar from starch in the United States began in a small factory at Sacketts Harbor, N. Y., in 1831, under the direction of a chemist named Guthrie. In March 1865 Dr. Goesling began making glucose under a patent he had procured. The sample exhibited led to the formation of a stock company which purchased of Goesling, Bradley & Briggs their patent for manufacturing sugar and syrup from Indian corn. The company began the manufacture of glucose in the old sugar-refinery in Rose street, New York. Unfortunately Dr. Goesling, the German chemist who was to superintend the manufacture of glucose, died before the first lot of glucose was marketed, and with him perished some of the secrets of manufacture.

By 1870 the new industry had so far developed as to be mentioned in the census of that year. In 1874 the Buffalo Grape-Sugar Company was organized; it grew into a vast concern, and might be said to be the parent of the present industry.

In 1884 there were 29 factories engaged in the manufacture of sugar or syrup from corn and having a combined capacity for absorbing 40,000 bushels of corn per day. At present there are 89 factories which in 1914 used corn, potatoes and wheat flour. These materials were turned into starch, glucose syrups, grape-sugar, corn oil and stock feed of an aggregate value of $68,000,000. Of the 89 factories in 1914, there were 51 in Maine, 7 in Minnesota, 5 in Illinois, 4 in Massachusetts, 3 each in Connecticut, Indiana and Iowa, 2 each in New York and Ohio, and 1 each in California, Florida, Maryland, Michigan, Missouri, Nebraska, New Jersey, Pennsylvania and Wisconsin. These factories used in 1914 2,480,792,405 pounds of corn.

As found in the market glucose consists of varying proportions of maltose, dextrins (gummy matters), and dextrose (the true glucose) and from 15 to 22 per cent of water. When starch is hydrolysed by dilute acids it breaks first into dextrins; these into maltose; and this finally into dextrose. By varying the quantity of acid the pressure, and the time of boiling, varying products result — glucose, 70-sugar, 80-sugar, and commercial dextrose. Dextrose is sometimes called "solid glucose." It is a mass of white needle-like crystals, microscopic in size, entangling a small percentage of a non-crystallizable syrup. In the case of glucose the time of boiling is purposely made short in order to gain more of the intermediate products and less of the dextrose. As usually prepared, the starch "milk" is sprayed into a boiler containing water acidulated with hydrochloric acid under pressure of about 50 pounds of steam, and boiled for about 10 minutes. This converts about one-fifth of the starch into true glucose (dextrose), the remainder being about three parts maltose and two parts dextrins. When made from potatoes, the acid used is sulphuric, and the hydrolysis yields a product about half-maltose and half dextrins.

The process of manufacture has been greatly improved, so much so that, while in 1882 26 to 30 pounds of glucose was obtained from one bushel of corn, 40 pounds is now obtained.

Manufacture, Composition and Commercial Standard.—The manufacture requires 80 hours, and includes 18 processes of manipulating the corn (and starch obtained therefrom): (1) steeping; (2) grinding; (3) separation of the starch; (4) cleaning the starch; (5) collecting the starch; (6) washing the starch; (7) conversion by the action of hydrochloric acid; (8) neutralization with soda; (9) bag-filtration; (10) bleaching with sulphurous acid; (11) bone-black filtration; (12) concentration; (13) second bag-filtration; (14) acid treatment; (15) second bone-black filtration; (16) final concentration; (17) final filtration; (18) final chemical adjustment. After the corn is steeped it is ground in water, and the wet starch separated and converted in copper converters by the action of hydrochloric acid, which is later neutralized by chalk or other alkali; subjected to filtration, then concentrated in a vacuum-pan until it tests 41° to 45° Baumé, the difference being in the amount of water eliminated; the product, glucose, a liquid substance, or grape-sugar if the process of conversion is carried farther. If the conversion of starch with acid is carried to a point where a dilute iodine solution will just give a distinct color-reaction, we have glucose; continued to where 95 per cent alcohol gives a faint cloud, hardly a precipitate, we have grape-sugar containing about 85 per cent of fermentable sugar. For still higher converted sugars a time-factor must be introduced. Carried beyond a given point, a back conversion takes place, with strong decomposition and loss of purity. The ratio of the fermentable sugar to non-fermentable sugar depends on the accuracy in stopping the conversion, for neutralization, at the exact point decided upon. This ratio determines whether the product is glucose or grape-sugar, and no sharp dividing line exists. The rotating powers of glucose and grape-sugar depend absolutely on this ratio. Actually no two batches of commercial glucose or grape-sugar are identical, but for all practical purposes they are alike, as a few points either way from the standard decided upon will make no difference in the appearance, taste or working qualities of these products.

Non-crystallization.— Glucose does not crystallize, as does cane-sugar (sucrose), A chemical process was devised by Dr. Arno Behr for the crystallization of glucose, but it is regarded as impracticable by reason of being too expensive. Dr. Behr added to the liquid glucose a very small quantity of crystallized anhydrous dextrose. The mixture is filled into molds, and in 72 hours will be a solid mass of crystals of commercial dextrose. The blocks are next placed in a centrifugal machine to throw out the still liquid syrup, and the anhydrous dextrose remains as a crystalline mass.

Varieties of Use.— Because glucose does not crystallize it is used extensively in the preserving industry. Fruit put up in a syrup wholly or partially made of glucose has a more plump and natural appearance than if preserved in sugar. Comb-honey, when put into glass jars, is surrounded by strained honey to which has been added a proportion of glucose which prevents its candying, and therefore the honey always remains pleasing to the eye. It is very largely used for mixing with cane-sugar molasses; as a substitute for extract of malt in brewing; and very freely in the manufacture of candy. It is said to have two-thirds the sweetening power of cane-sugar. The extent to which glucose is used in the making of jams, jellies, marmalades, preserves and canned fruit, together with tables showing the composition of commercial glucose and the composition of the ash of glucose, are given in Bulletin No. 66, Bureau of Chemistry, United States Department of Agriculture; also with extensive tables showing the composition of the jams and other preserves in comparison with such as contained no glucose. As a food it is very largely consumed as table syrups which are 85 per cent glucose and 15 per cent sugar-house syrup. These syrups are well liked and much purer than molasses. Glucose is also used as a filler for cheap soap, and in leather and tanning extracts.

Some candies are nearly all glucose, particularly such as are sold at the lowest prices. In the high-grade confections the finest grade is used, not as a substitute for sugar, but in the place of acids to prevent the cane-sugar from graining, for which purpose only a small quantity is used. In the brewing of ale and beer it is claimed that a lighter liquor results when a proportion of glucose is added to the malt and that it is more palatable. It is assumed that commercial glucose is the same as the glucose which comes from the action of diastase in changing the starch in malt into maltose sugar. As glucose is flavorless, all of the malt cannot be dispensed with. It is claimed that 100 pounds of glucose or grape-sugar is equal to 123 pounds of barley-malt, and is much cheaper.

The Wholesomeness of Glucose.— This is really the most important question connected with glucose, and one that is still unsettled. It is a problem for the physiologist rather than the chemist. Owing to many improvements made in the last 30 years, the conclusion rendered by the government's experts in 1884 could be made much more emphatic in 1916. It was as follows: "The starch-sugar thus made and sent into commerce is of exceptional purity and uniformity of composition, and contains no injurious substance. Though at best having only about two-thirds the sweetening power of cane-sugar, yet starch-sugar is in no way inferior to cane-sugar in healthfulness, there being no evidence before the committee that maize starch-sugar, either in its normal condition or fermented, has any deleterious effect upon the system, even when taken in large quantities."

Dr. H. W. Wiley, formerly chief chemist of the United States Department of Agriculture, testified before a committee of the United States Senate as follows: "I have had occasion to make careful examinations of almost every variety of food that has ever been exposed upon our markets for sale. In my opinion glucose is not deleterious to health. It is wholesome, somewhat sweet, readily digested. I have always found, from the time I first began to investigate food products, that the series of foods known as glucose or grape-sugar, when properly made, are valuable food material and not injurious."

It is conceded by all that glucose is as readily digested as maltose, which is esteemed as a food for convalescents. It is sufficient to add here that the industry adds materially to the revenue of the corn-producer, is a great boon to the farmer. The total production of glucose and syrups alone was valued at $18,541,429 in 1914 and at $17,922,514 in 1909, the increase being 3.5 per cent. The total quantity of glucose manufactured during 1914, including that consumed in establishments where produced, was 847,180,968 pounds. The output of grape-sugar increased from 159,060,478 pounds, with a value of $3,620,816, in 1909 to 174,368,818 pounds, valued at $3,765,515 in 1914, or 9.6 per cent in quantity and 4 per cent in value.

Bibliography.— Armstrong, E. F., 'The Simple Carbohydrates and the Glucosides' (London 1910); Dubrunfaut, 'Sucrage des Vendages avec les Sucres raffinés de Canne de Betterave'; Frankel, J., 'Practical Treatise on the Manufacture of Starch, Glucose, Starch-sugar and Dextrine' (Philadelphia 1881); National Academy of Sciences, 'Report on Glucose,' prepared in response to a request made by the Commissioner of Internal Revenue, with bibliography of starch-sugar arranged chronologically, 1790–1883 (Washington 1884); 'Glucose in Confectionery,' a statement from the National Confectioners' Association of the United States (Philadelphia 1898).

RICHARD FERRIS.

GLUCOSIDES, gloo'kō-sidz, a class of complex vegetable substances which under the influences of heat, enzymes or chemical action produce a glucose. Most of the known glucosides are derived from dextro-glucose, others from rhamnose or galactose. When the sugar is rhamnose they are known as rhamnosides; if arabinose, they are known as arabinosides, etc. Glucosides containing rhamnose require a specific enzyme to effect their hydrolysis. There are a great many glucosides in nature, and within recent years a large number have been made artificially. The chemical composition of the artificial glucosides is well understood, since they are the result of synthesis, but the make-up of the natural glucosides is not clear. From comparison with the synthetic glucosides, however, it has been generally accepted that natural glucosides are formed by the elimination of water between a hydroxyl group of the sugar and one from the other compound. Although present in plants in very small quantities, glucosides play a very interesting rôle in nature. By reason of their bitterness and of often being poisonous, they preserve seeds from destruction by animals, man included, until they shall have ripened, and then on germination plant enzymes or ferments acting on the glucosides set free a certain amount of sugar, which is of much service to the young developing plant. An excellent illustration of their protective qualities is seen in persimmons, which, when green, are so puckery by reason of the glucoside tannic acid that they are left severely alone. When ripe, however, the tannic acid is converted largely into sugar, and the fruit, then eaten and carried about by animals, can distribute its seed.

Glucosides are obtained by extracting the plant substance with water or alcohol. It is necessary, in most cases, to destroy the accompanying enzyme when water is used as a solvent, otherwise the glucoside is destroyed during the process. The glucosides generally are colorless, crystalline substances having a bitter taste. A typical example is amygdalin, of the bitter almond, and the kernels of peach stones. The larger part of the glucosides belong to the class known as «saponins» from their resemblance to the specific glucoside obtained from the root of the *Saponaria rubra*. The saponins are nearly all colloidal substances dissolving freely in water, and yielding a froth when the solution is shaken, and produce soapy emulsions with fats and oils. They are insoluble in alcohol, ether and benzol. From their aqueous solutions the saponins are precipitated by adding ammonia sulphate. Although one or two of the saponins are useful in the arts (as in bottled soda water and ginger beer, to hold the froth) they are practically all of a poisonous nature. A curious use is made of some of them in the East, where they are strewn upon the surface of shallow waters, with the effect of killing the fish therein: the very small portion of poison taken in by the fish does not make it unfit for human food. Another important class of the glucosides, though much fewer in numbers than the saponins, are the cyanogenetic glucosides, thus named because they yield hydrocyanic acid as one of the products of hydrolysis. They are found in flax and sorghum, and in some of the laurels, magnolias and roses, as well as in other representatives of some of the higher orders of plants. The significance of the glucosides in the plant economy is not known, and eminent authorities differ in their opinions upon this question. In most, perhaps in all, cases the glucoside is accompanied in the plant by its appropriate enzyme, which is able to hydrolyse it. They do not exist in the same cell, but are brought together by the breaking down of the cellular structure. Observation has shown that salicin is formed in the willow during daylight, but after the light has gone the salicin is split into sugar and the alcohol saligenin, by the activity of salicase.

The more important glucosides are *amygdalin* — of bitter almonds; *prunasin* — of wild cherry; *sambunigrin* — of the common elder; *arbutin* — of the barberry; *phloridzin* — of the bark of apple and pear trees; *salicin* — of willow bark; *populin* — of the poplar; *coniferin* — of fir trees; *sinigrin* — of black mustard; and *indican* — of the indigo plant. It is interesting to note in passing that in several instances cultivation of wild plants has had the effect of reducing the contained glucoside to an almost unrecognizable quantity. Many glucosides are affected by heat. Some are split by cooking in water, but a boiling temperature is apt to destroy the action in many. Thus it is necessary to use cold water if one desires to obtain the volatile oil of mustard in making a mustard plaster. Many fungi are capable of breaking down glucosides, which fact is of a great deal of practical importance in medicine, for some active remedies which contain glucosides, if kept too long on the druggist's shelf, develop molds within them. These destroy the active principle of the drug and thus render it useless. In medicine the most important glucoside containing drugs belongs to what is known as the «digitalis group.» Thus digitalis contains four or five, strophanthus two, apocynum two, and squills the same number. These bodies are all heart tonics in small doses and heart poisons in larger amounts. Consult Armstrong, E. F., 'The Simple Carbohydrates and the Glucosides' (New York 1912); Haas, P. and Hill, T. G., 'An Introduction to the Chemistry of Plant Products' (New York 1913).

GLUE, an impure gelatine, used as an adhesive. The substances of which glues are made are *ossein* of bones and hides, *chondrigen* of cartilage, *isinglass* from the bladders of fishes, and *elastin*, found in certain ligaments.

In the modern method of making glue from bones they are first crushed, and then placed in pots of stone in a tank or retort, and their fat is extracted by boiling them in a solvent, usually a cheap grade of naphtha. The heat is supplied by steam coils. The first vapors of naphtha contain the moisture of the bones, and these are carried off from the top of the retort into a condenser. When moisture ceases to come over with the naphtha the retorts are closed, and the naphtha with its dissolved fat is drawn off at the bottom. This operation is continued with new naphtha three or four times; the operation requiring about 12 hours. The naphtha remaining in the bones is blown out by passing high-pressure steam through the retort. The bones are then boiled in water under steam pressure of 15 pounds to the square inch, which is later reduced to four or five pounds, when the glue in the interior of the bone fragments begins to ooze out. This is washed down at intervals with a spray of hot water. When the solution in the boiler contains about 20 per cent of glue, it is drawn off, skimmed of any grease which may have escaped the naphtha, clarified with one-half of 1 per cent of potassium alum, agitated at a temperature of 175° F., and then strained through canvas or fine wire gauze. The glue solution then goes to the concentrators where its moisture is removed by the vacuum method at a comparatively low temperature. The glue is bleached by passing sulphur dioxide through it while in the liquid form, and it is then run into troughs to the depth of five inches. When the «jelly» has set, it is cut into thin slices by a wire knife, and placed upon wire nets to dry. As this jelly melts at about 75 degrees, the air currents used in drying it have to be cooled below this temperature in summer, and the freezing air in winter has to be warmed to a drying degree. The slices or sheets are dry in four or five days, then still containing 10 to 13 per cent of water. When prepared from clippings of hides, these are steeped in lime water for several days to remove the hair and blood, and then drained and dried in a current of air, that the lime may absorb carbonic acid, and thus prevent the injurious effects of the alkali upon the gelatine. The clippings are then washed first with water and then with dilute hydrochloric acid and again dried. They are then enclosed in sacks and boiled in water until the solution is found to gelatinize firmly on cooling. The impurities are allowed to settle, and the residuum to gelatinize in shallow wooden boxes; it is then cut into slices and dried upon nets. Good glue is semi-transparent, and free from spots and clouds. Marine glue, a composition used for cementing materials that are exposed to moisture, is made by dissolving 1 part of india-rubber in 12 parts of mineral naphtha, and adding 20 parts of powdered shellac; it resists wet, and cements glass and metals as well as wood. Fish glue is made from the skins of fluke and other flatfish and the bladders and offal of any kind of fish. The product is a very strong adhesive, but needs deodorizing; this is accomplished by adding about 1 per cent of sodium phosphate together with one-fourth of 1 per cent of saccharin. White fish-glue, or diamond cement, is made of isinglass dissolved in alcohol. Before use on important work glues are subjected to tests for moisture and ash; for acidity; for contained fat; for gelatine content; for water absorptive capacity; besides several tests of the jelly as to adhesive power, viscosity, tensile strength and tendency to foam (because of included peptones).

The glue industry in the United States was founded by Peter Cooper in 1827, when he established a factory in Brooklyn. About the same time a factory in Philadelphia was started by Charles Baeder and William Adamson. At present glue factories are centralizing near the great slaughter-houses of the Middle West, the sources of raw supplies, and the larger packing concerns, notably the Armours and the Swifts in Chicago and the Cudahy Company in Omaha, have their own glue plants. (See PACKING INDUSTRY.) The factories still in the East are largely supplied with imported hides. The export trade is steadily growing and has passed the $500,000 mark per annum. France alone surpasses America in the quality of its finer glues, and these are imported for use in making straw hats. The finest glues made in the United States are prepared from sinews, and it is likely that continual experiment upon them will result in a product equal to the best imported from France.

GLUME. See GRASSES.

GLUT-HERRING, or BLUEJACK, a herring (*Pomolobus æstivalis*), abundant in the Southern States, and very similar to the alewife (q.v.), but is more elongated, is darker on the back and has a black peritoneum and comparatively small eyes. The quality of its flesh is poor.

GLUTEN (Lat., glue), that part of the protein content of wheat which is insoluble in water. It is a combination of the two proteid substances *gliadin* and *glutenin*, the first containing 17.66 per cent of nitrogen, and the second, 17.49 per cent. These components, however, do not combine in the wheat kernel, nor in wheat flour to form gluten: it requires the presence of water to initiate the combination. Gluten is insoluble in water containing salts, but the gliadin component is soluble in distilled water and also in alcohol. As found in wheat flour dough, gluten consists of about two-thirds gliadin and one-third glutenin, and it is this constituent of wheat flour which causes the dough to be sticky, entrapping the bubbles of gas from the fermentative action of the yeast, or from the chemical action of baking-powder, and «lightening» the dough into a «sponge.» Some glutens are tough and elastic, others soft and «rotten.» The latter lack the quality of absorbing water, and do not hold the sponge made by the yeast, thus making a poorer bread, and fewer loaves to the barrel of flour. The strength of a gluten depends upon the proportion of gliadin to glutenin, and also to the presence or absence of certain mineral salts. The so-called «hard» wheats and those grown in hot countries have a larger gluten content than the «soft» wheats, or those grown in cold climates. The amount of gluten from any sample of flour, also, increases with the hardness of the water used and with the time the dough is permitted to stand, this increase ranging up to more than 6 per cent. The relative elasticity of the glutens in different samples of flour is sometimes tested with an instrument called the aleurometer, which operates on the expansion of wet gluten when exposed to a temperature of 300° F., but this test fails in the vital point that the value of a gluten depends not on its quantity, but on its quality. Of two samples of flour containing equal parts of gluten, one may be worth in bread-making more than twice the value of the other.

To obtain gluten from wheat, the grain is reduced to dough, and the starch removed by mechanical processes, the resultant product being a grayish, tough, elastic, sticky substance which, when rightly proportioned in its gliadin-glutenin content, is capable of being drawn out into long bands or shreds. Crude gluten consists of about 74 per cent of gliadin and glutenin, 7 per cent of non-gluten proteins and the remaining 19 per cent of fat, carbohydrates, fibre and mineral salts. In the domestic operation of separating the gluten from flour for making gluten bread for diabetic patients, a «strong» flour is made into stiff dough with hard water. This is allowed to stand for about an hour. The dough is then kneaded in water in small portions usually placed in loose muslin bags, the starch escaping through the bag and producing a milky appearance in the water. The kneading is continued in successive waters until no more «milkiness» washes out.

In its highest refinement, gluten exhibits a fine molecular structure, delicate and sensitive to atmospheric conditions, and requires, after separation, immediate handling in its preparation for food.

About 16 pounds of gluten is obtained from 200 pounds of wheat-flour. On account of its high content of nitrogen, gluten soon deliquesces, sours and spoils after the separation from the starch, and demands an immediate treatment if desired for food purposes. What are known as gluten feeds are by-products in the manufacture of starch and glucose from corn, and the dried residues from the distilling of spirituous liquors. They have a nutritive value about equal to brewer's grains. To the glucose and starch makers corn consists of starch, gluten, germ and bran, all but the starch being by-products. They are separated by mechanical processes. The free germs of the corn are dried, ground to meal, the oil extracted by solvents leaving oil-cake, a cattle-feed extensively used. The wet starch is run through vibratory sieves and over long wooden tables, the starch and gluten forming the mixture which passes through the sieves; the starch being deposited by gravity, the gluten liquid passes off at the ends of the tables. When evaporated, pressed and dried, this constitutes the gluten-meal of commerce. About five and one-half pounds is obtained from one bushel of corn.

The composition of gluten-meal is, protein 38 per cent, fat 3 per cent and starch 40 per cent. This is one of the richest and best feed products on the market. The nutritive value is very high, and the factor of digestibility ranges from 92 to 96 per cent. Gluten-meal is treated for the recovery of its starch, and gives two new products, a concentrated feedstuff, characterized by the large amount of proteids (60–70 per cent) it contains, and a maltose syrup. This feedstuff is suitable for animal consumption, and also for raising the percentage of proteids in feeds that have a small amount of these substances. When the wet bran, germs and gluten are mixed in the proportions as obtained from the original corn and the mixture dried, the resulting feed is known as gluten-feed. This is the most common feed product in the starch and glucose industry, and represents about 80 per cent of the by-product output. Its feeding value is very high, and its digestibility above 90 per cent. Its composition shows about 28 per cent protein and 3 per cent fat.

Corn oil-cake and gluten-meal are exported extensively. The bran and gluten feed is used almost exclusively in the United States. The production per bushel of corn is about 12½ pounds of food, outside of the glucose or starch.

The waste product in the manufacture of starch or sugar is relatively much richer in oil and protein than is corn. Most factories are removing part of the corn-oil from the waste, so that nearly all the gluten-meals carry much less oil than they did a few years ago. Gluten-feeds differ from gluten-meals in that they contain a good deal of the corn-bran, and hence less of protein and digestible carbohydrates, and more of the indigestible woody fibre. The relation of gluten to bread making is set forth in detail in Bulletin No. 67, United States Department of Agriculture. The food value of gum-gluten has been outlined by Prof. Nelson Clark Parshall in a pamphlet published by the Pure Gluten Food Company, New York. Consult also Jago, W. C., 'The Technology of Bread-Making' (London 1911); United States Bureau of Chemistry, Bulletin 108, 'Feeding Stuffs of the United States' (Washington 1908).

GLUTTON, the English name in Europe of the large fur-bearing badger-like animal known in North America as wolverine (q.v.). It was renowned in mediæval literature for its excessive greed; hence the English words «glutton» and its derivatives. The alleged greed is, however, a matter of fable far more than of fact, yet gross exaggerations of the animal's voracity and sagacity survived even in educational books until very recent times. That it has in reality a quite extraordinary strength and cunning, giving some foundation for the superstitious history, will be seen by reference to the article WOLVERINE.

GLYCERINE, or GLYCEROL. In 1783 Scheele showed that by acting upon olive oil by oxide of lead a substance may be obtained which has a sweetish taste; and in the following year he showed that the same substance may be had by acting in a similar manner upon other oils and fats, such as butter. He also observed that the substance in question may be obtained in the form of a syrupy fluid; that although it has a sweetish taste like sugar, it cannot be fermented; and that although it gives oxalic acid by oxidation, it differs from sugar in many respects. He failed, however, to ascertain its true relation to the oils which furnish it, and to the lead plaster (or «lead soap») which accompanies its formation. The true explanation of the reactions was given some 30 years later by Chevreul, as a result of his famous researches upon the animal fats, which were begun about 1811, and were concluded about 1823. In the course of these researches Chevreul showed that an animal fat consists, in general, of a mixture of several definite chemical substances, each of which is itself a fat, and each of which consists of Scheele's sweetish substance (which is now called «glycerin»), combined with an organic acid. When the fat is treated with an alkali, or with lime or oxide of lead, the organic acid that is present combines with the alkali, or the lime, or the lead, to produce a new substance called a «soap,» the organic base (glycerin) which was previously combined with the acid being thereby set free. Since the time of Scheele and Chevreul much attention has been paid to glycerin and its compounds, and it is now universally agreed that glycerin is a trihydric or triatomic alcohol (see ALCOHOL), having the formula $C_3H_5(OH)_3$, that is, containing the radicle C_3H_5 in combination with three OH groups. Hence glycerol bears the same relation to ordinary ethyl alcohol as orthophosphoric acid bears to nitric acid. And just as tribasic phosphoric acid forms three distinct classes of salts with three different proportions of the same base, so does glycerol form three distinct classes of esters: monoglycerides, diglycerides and triglycerides, and that it forms an acid and an oxide, and various substitution compounds and esters, of which latter class the fats (q.v.) are the most important members, and are distinguished by the name of «glycerides.»

Glycerin does not exist as such in the fats and fatty oils, but is formed by the assimilation of three molecules of water. However, glycerin does occur in nature in the uncombined form, notably as a constituent of palm-oil, and it is also a product of the alcoholic fermentation of sugar, and is therefore a normal constituent of beer, wine, etc., 100 parts of sugar yielding in fermentation 3.5 parts of glycerin. On the large scale, however, glycerin is prepared by the decomposition of fats. In commerce, five varieties of crude glycerin are recognized: (1) crude saponification glycerin; (2) crude distillation glycerin; (3) Twitchell crude glycerin; (4) fermentation glycerin; (5) soap lye glycerin. The purest form results from the saponification of fats with lime in open vessels: that from soap lye processes may be equally pure if from a good class of fats. The other three sorts contain characteristic organic impurities which are not eliminated by the best known refining processes. The largest output is the soap lye grade.

In soap making the fat is decomposed by heating with an alkali, the soap which is formed by the combination of the alkali with the organic acid of the fat remaining in solution until it is precipitated by the addition of common salt. The fluid that remains after the soap has been so precipitated contains the liberated glycerin, which can be separated by distilling in a partially exhausted boiler, the glycerin passing over with the water vapor, from which it may be subsequently separated by re-evaporation in a vacuum. In its commercial form it contains from 80 to 86 per cent of pure glycerin, 10 per cent of salts and 4 to 10 per cent of water.

Crude distillation glycerin is obtained in large quantities as a by-product in the manufacture of so-called «stearin» candles. In this case the fat is not saponified by an alkali, but beef fat, or some other fat that is rich in stearin, is acted upon by superheated steam, by which the stearin, or stearate of glycerin, is resolved into free stearic acid and free glycerin. Fat undergoes a similar transformation when treated with a mineral acid; but this method of producing glycerin has the disadvantage that the mineral acid is likely to combine to a certain extent, either with the glycerin, or with the liberated fatty acid, necessitating a subsequent treatment for its removal.

Glycerin is refined by distillation of the crude, and, if for dietetic or pharmaceutical purposes, is redistilled. The finest grade is triple distilled. Pure glycerin is a colorless, odorless, syrupy liquid, with an oily feel and an intensely sweet taste, and a specific gravity of about 1.27. It is insoluble in ether, but it mixes in all proportions with water and with alcohol. It has a considerable affinity for water, and absorbs moisture from the air quite readily to the extent of 50 per cent of its weight. It boils at about 600° F., but with partial decomposition. Under reduced pressures it boils at lower temperatures. At a pressure of 12.5 millimetres of mercury, for example, it boils at 356° F., and may be distilled without change. By subjecting pure glycerin to a temperature of 15° to 20° F., it will solidify in rhombic crystals, which melt at 68°. A large quantity of glycerin at 32° may be solidified by the introduction of a few glycerin crystals. Glycerin burns with an almost colorless flame, and dissolves many organic bodies that are insoluble in water. It also dissolves iodine, and many of the metallic oxides.

The solvent properties of glycerin render it valuable in pharmacy, and it is added to baker's cake in small quantities to keep it moist. Large quantities are used in the manufacture of toilet soaps, creams and washes, as a preservative medium, and in gas meters and other mechanical appliances in which a liquid is needed which will not readily freeze nor evaporate, but the largest part of the production is made into dynamite, blasting gelatine and smokeless powders.

GLYCIN, glī'sĭn. See GLYCOCOLL.

GLYCOCHOLIC (glī-kō-kŏl'ĭk) **ACID**, an organic acid, whose sodium salt is one of the chief constituents of the bile of certain of the vertebrates. It may be most conveniently prepared by the following method: A drop of hydrochloric acid is added to fresh bile, generally of the ox, and the mixture is shaken and filtered. The filtrate is shaken with hydrochloric acid and ether and allowed to stand until the glycocholic acid separates in the form of a bulky mass of colorless needle-like crystals. These are collected upon a filter, washed with water containing hydrochloric acid and ether, and finally purified by recrystallization. Glycocholic acid is slightly sweet and bitter in its aqueous solution. It is readily soluble in alcohol, but dissolves sparingly in water, ether and other solvents. It forms numerous salts, known as glycocholates, which are all soluble in alcohol. Those of the alkalis are very sweet, and are freely soluble in water, and yield lathers, like soap. Glycocholic acid is an amido-acid and has the formula $C_{26}H_{43}NO_6$, and when heated with potash it is resolved into cholic acid ($C_{24}H_{40}O_5$) and glycocoll ($C_2H_5NO_2$), apparently according to the equation $C_{26}H_{43}NO_6 + H_2O = C_{24}H_{40}O_5 + C_2H_5NO_2$.

GLYCOCOLL, glī'kō-kŏl, **GLYCIN, GLYCOCIN, AMINO-ACETIC ACID**, or **GELATIN SUGAR**, a singular chemical substance obtained by heating glycocholic acid (q.v.) with an alkali, or by the decomposition by long-continued boiling of gelatin, glue or gelatinous tissues, with sulphuric acid, or with potash or baryta. When perfectly pure it crystallizes in tabular, monoclinic crystals which darken at 430° F. and melt at 450° with the evolution of gas, but slight quantities of certain impurities induce remarkable changes in its crystalline form. It is insoluble in alcohol and in ether, but is sparingly soluble in water, its solution having a sweet taste. It is the chief amino-acid in the sugar-cane. According to its mode of formation from glue, glycocoll is a sugar, the glue acting the part of a glucoside; but it resembles an acid (although it is neutral to litmus paper) inasmuch as it combines with metallic oxides to form salts. It does not form salts with the metals of the alkalis, and probably not with those of the alkaline earths. In combining with acids, glycocoll acts as a base, forming definite salts such as the nitrate, acetate, oxalate, sulphate and hydrochloride. In these compounds the glycocoll has strongly basic properties, and, indeed, it is usually described as a base. The chemical formula of glycocoll is $C_2H_5NO_2$; or $CH_2(NH_2).COOH$. Under the name «glycin» it is used as a photographic developer in place of pyrogallol.

GLYCOGEN, glī'kō-jĕn ($C_6H_{10}O_5$), was discovered in 1857 by Bernard and was given the name «animal starch.» It belongs to that class of the carbohydrates called the polysaccharides; these are convertible into simple carbohydrates when hydrolysed. Glycogen is the reserve carbohydrate of the animal organism in which it appears to take the place of starch, and it is a normal constituent of all developing cells. It is found in the livers of most animals to the amount of 10 per cent and to some extent in the muscles and other parts of fœtal animals. It is formed by the action of a ferment on starches, transforming them into sugars which undergo some alteration, becoming less soluble, and are then deposited in the liver and the muscular tissue. This storing of glycogen takes place in times of liberal feeding, but it disappears rapidly from the muscles in times of exertion. Glycogen is prepared from finely minced fresh liver, which is thrown into boiling water acidified with acetic acid. The proteins which coagulate are filtered out, and the remaining proteins precipitated from the filtrate with trichloracetic acid. From the remaining filtrate the glycogen is precipitated by adding alcohol. It is purified by resolution and reprecipitating with alcohol. It is obtained as an amorphous, snow white powder, yielding an opalescent solution with cold water. It does not ferment, nor does it reduce Fehling's solution, and it is not affected by boiling concentrated solutions of the alkalis. Acids hydrolyse it eventually to dextrose, but it passes through the phases of dextrins and maltose. Diastase also converts it to dextrins and maltose. The chief interest attaches to the physiological function of this substance, and the divergent views taken with regard to it by different writers. Thus it is said to be the substance in the liver mainly concerned in the conversion of starch into sugar. Other physiologists affirm that no such transformation takes place, there being no proof of the increase of sugar after the action of the liver; so that at the present time its exact functions are obscure. It has been suggested that the sugars that are taken into the system with the food are stored up in the liver in the form of glycogen, to be drawn upon subsequently, according to the needs of the system. In cases of diabetes glycogen is found in much larger quantities than usual, and in cases of starvation it is almost wholly absent. It is contained in the white blood corpuscles in very small amount. It is found in oysters to the extent of 3 per cent. It is found also in the cells of certain fungi, and at times in yeast where it may be very abundant, and then quickly disappear.

GLYCOL, or ETHYLENE ALCOHOL, the most important of the dihydric alcohols (see ALCOHOL and FATTY COMPOUNDS) may be regarded as derived from the hydrocarbon ethane, C_2H_6, by the substitution of two molecules of hydroxyl (OH) for two molecules of hydrogen. It therefore has the formula $C_2H_4(OH)_2$. Glycol may be prepared by acting upon ethylene dibromide, $C_2H_4Br_2$, by potassium carbonate, K_2CO_3. The reaction is $C_2H_4Br_2 + K_2CO_3 + H_2O = C_2H_4(OH)_2 + 2KBr + CO_2$. Glycol is a colorless, odorless liquid, having a specific gravity of about 1.12, and a sweetish taste. It boils at about 388° F., and solidifies at 11° F. It mixes in all proportions with water and alcohol, and is used to some extent as a solvent. A great many compounds have been derived from glycol, but they are not of general interest. The word "glycol" is also used as a generic name for all the dihydric alcohols.

GLYCOLLIC (glī-kŏl'ĭk) **ACID, or OXYACETIC ACID,** an organic acid having the formula $HO.CH_2.COOH$, whose potassium salt (that is, potassium glycollate) exists in the grease obtained from sheep's wool, in the juice of unripe grapes and as the principal acid in the juice of the sugar-cane. It is also found in the lime precipitate after treatment of the juice of the sugar beet. It may be prepared by heating a mixture of glycerin, water, calcium hydrate and precipitated silver oxide for four hours, after which the fluid is filtered, saturated with carbon dioxide, boiled, filtered again and finally evaporated until calcium glycollate crystallizes out. The calcium glycollate is next decomposed by oxalic acid, and the filtered solution is neutralized with carbonate of lead. Upon evaporation, well-developed crystals of lead glycollate separate out; and a solution of these, when treated with the proper amount of sulphuric acid, yields free glycollic acid. By evaporation in a vacuum over concentrated sulphuric acid, and subsequent recrystallization from solution in anhydrous ether, the acid may be obtained in a very pure form. It is freely soluble in water, in alcohol, in ether and in acetone. Concentrated nitric acid oxidizes it to oxalic acid; and when distilled with excess of quicklime it decomposes with liberation of methane and hydrogen. Glycollic acid forms an extensive series of salts called glycollates, those of the alkalis being deliquescent, and it also yields numerous esters and other organic derivatives.

GLYCOSURIA, the presence of glucose in the urine. See DIABETES MELLITUS.

GLYCYRRHIZIN, glis-ĭ-rī'zĭn, or **LIQUORICE SUGAR,** an organic substance, the calcium and potassium salts of the tribasic glycyrrhizic acid, which occurs in liquorice root (*Radix Glycyrrhizæ*) to the extent of 8 per cent, together with starch, malic acid and various other matters. In the juice of the bitter Anatolian liquorice the proportion ranges from 17 per cent as high as 25 per cent. It may be prepared by extracting the dried and pulverized liquorice root with boiling water containing a small quantity of milk of lime, and precipitating the concentrated extract with cold acetic acid. The gelatinous precipitate is purified by dissolving it in 50 per cent alcohol, filtering through charcoal, and finally evaporating at 212° F. When dry, glycyrrhizin is an amorphous solid, which swells up in cold water but does not dissolve. It is only slightly soluble in alcohol or ether, but dissolves in hot water, and also in boiling glacial acetic acid. It does not reduce Fehling's solution, nor the ammonical silver solution, but has been regarded as a glucoside. Although boiling with dilute acids decomposes it, it does not appear that any glucose or other sugar is formed, the chief products of the decomposition being parasaccharic acid and a brownish resin called glycyrrhetin.

GLYN, Elinor, English novelist: youngest daughter of Douglas Sutherland of Toronto, Ontario. In 1892 she married Clayton Glyn, J. P., (d. 1915). Her publications are 'The Visits of Elizabeth' (1900); 'The Reflection of Ambrosine' (1902); 'The Damsel and the Sage' (1903); 'The Vicissitudes of Evangeline' (1905); 'Beyond the Rocks' (1906); 'Three Weeks' (1907); 'The Sayings of Grandmama' (1908); 'Elizabeth Visits America' (1909); 'His Hour' (1910); 'The Reason Why' (1911); 'Halcyone' (1912); 'The Contrast, and Other Stories' (1913); 'The Sequence' (1913); 'Letters to Caroline' (1914); 'Three Things' (1915); 'The Career of Catherine Bush' (1917).

GLYNN, Martin H., American politician and editor: b. Kinderhook, N. Y., 27 Sept. 1871. He was graduated at the head of his class at Saint John's College, Fordham, N. Y., in 1894, and four years later received the degree of A.M. from this institution. Since 1895 he has been managing editor of the Albany *Times-Union* and in 1897 was admitted to the bar. He represented the 20th New York District in the 56th Congress, 1899–1901; was vice-president of the United States Commission at the Louisiana Purchase Exposition, Saint Louis, in 1904, and in 1906–08 was comptroller of New York State. In November 1912 he was elected lieutenant-governor of New York and on 14 Aug. 1913 assumed the office of governor, after impeachment proceedings had been instituted against William Sulzer. From 18 Oct. 1913 he was in full possession of the office, when Governor Sulzer was removed by Court of Impeachment. Mr. Glynn's term as governor expired 31 Dec. 1914. In 1914 he was nominated by the Democrats for governor, but was defeated by Charles S. Whitman.

GLYOXALIC ACID. See GLYOXYLIC ACID.

GLYOXALINE, a substance having the chemical formula $C_3H_4N_2$, and prepared by acting slowly upon cold glyoxal with strong ammonia in slight excess. Glycosine is thrown down as a brown precipitate, and the filtrate, which contains glyoxaline, is boiled with milk of lime (to expel the ammonia), after which it is evaporated to a syrupy consistency, treated with absolute alcohol to separate the mineral salts, and filtered, and the residue subjected to heavy pressure to gain all of the filtrate. The liquid so obtained is distilled, yielding pure glyoxaline in a crystalline mass of dazzling whiteness. Glyoxaline melts at 192° F., and boils at 491° F. It is freely soluble in water, alcohol and ether, and has an alkaline reaction. It acts as a base and forms salt. It is also the starting point for a series of organic compounds of analogous composition called glyoxalines. They are amidines in which two hydrogen atoms have been replaced, by the dyad group, —CR′═CR¹—. They are formed by the condensation of compounds containing the dicarbonyl group — CO.CO — with aldehydes and ammonia jointly.

GLYOXYLIC or GLYOXALIC ACID, an organic acid having the formula H.CO.CO-OH, and existing in unripe apples, grapes, plums, currants and others, and in rhubarb and young beets. It may be prepared (along with glyoxal) by oxidizing alcohol, glycol or glycerol with nitric acid. It is a thick syrupy liquid having a specific gravity of about 1.3, and when allowed to stand long over concentrated sulphuric acid it crystallizes in rhombic prisms containing water. Glyoxylic acid is very soluble in water, and can be distilled in a current of steam. It is a monobasic acid, forming crystalline salts called glyoxylates. By oxidizing agents it is converted into oxalic acid; by nascent hydrogen it is reduced to glycollic acid. It has also the properties of an aldehyde, reducing ammonical solutions of silver salts, forming a metallic mirror; also unites with alkaline bisulphites. It acts as a hydrolizing agent toward cane-sugar and starch, and prevents the fermentation of products thus formed, as it destroys the activity of yeast. Glyoxylic acid, when boiled with excess of lime water, yields calcium glycollate and calcium oxalate.

GLYPTICS, the art of engraving on gems and precious stones. It is generally done with diamond-pointed instruments, or instruments of exceeding hardness such as stellite.

GLYPTODONT, an armored edentate mammal of the extinct family glyptodontidæ, which developed mainly in South America during the Tertiary Period. Several genera and many species have been described from Patagonia, the Argentine pampas, Peru, etc., and northward to the southern United States, associated with the great ground-sloths. These glyptodonts were allies of the armadilloes, and some of the more ancient species of the pampean region were very armadillo-like. As time advanced, however, the race developed into huge and grotesque species, the larger ones reaching a total length, including the tail, of 12 or 14 feet, and standing five feet high. Their general appearance must have been that of gigantic, high-backed, long-tailed tortoises; their squarish heads were turtle-like in shape; and their movements must have been slow and heavy, for these animals were massively armored against the big and savage beasts of their time. The top of the head was protected by a bony casque. The body and much of the limbs were enclosed in an immense domed carapace, which almost reached the ground at the sides. "It was composed of very thick polygonal plates of bone (no doubt covered externally with horny plates) immovably fixed together by their rough edges, and ornamented with an elaborate pattern of sculpture which varied with the genus." The tail, often exceeding the body in length, was enclosed in a defensive sheath of the same nature, and constituted an extraordinary and powerful weapon of defense. In *Glyptodon* it was made up of a series of overlapping rings, each ring double and bristling with sharp spikes. In *Sclerocalyptus* there were several rings around the root of the tail, diminishing posteriorly, and then blending into a long, smooth, somewhat flattened tube of bone, blunt at the tip. In *Panocthus* this tube carried a few heavy, horn-like spikes; and in *Dædicurus* the very long tube "had its free end greatly expanded and thickened into a huge, club-shaped mass, on the top and sides of which were fixed long and sharp horns." The skeleton was of the armadillo type, but modified and strengthened, especially in the spine and legs, to enable it to bear the great weight of the carapace; and the hind legs were much longer than the fore legs, giving the hips a humped appearance. The broad feet had five toes in each pair, and in some species these were armed with powerful claws to enable them to dig roots and tubers. All the glyptodonts were plant-feeders, and entirely harmless. "When attacked by the saber-toothed tigers (*Smilodon*) or the great bears (*Arctotherium*) they needed only to squat down, bringing the edges of the carapace to the ground, and draw in the head," says Scott, "to be perfectly protected, while a sweep of the spiny and club-like or horny tail would have been fatal to everything in its path." The Texan species (*Gomphotherium*) was smaller, had less armament and a shorter tail, and survived on the Mexican border, according to Osborn, until near the close of the Ice Age. Consult Woodward, 'Vertebrate Paleontology' (London 1898); Ingersoll, 'Life of Mammals' (New York 1908) Scott, 'Land Mammals of the Western Hemisphere' (New York 1913).

ERNEST INGERSOLL.

GMEINER, mī'nẹr, **John,** American Roman Catholic clergyman: b. Bärnau, Bavaria, 5 Dec. 1847; d. Richfield, Minn., 17 Feb. 1915. He studied at Saint Francis' Seminary, Milwaukee, Wis., was ordained priest in 1870, was professor in the seminary, and later in Saint Thomas' Seminary, Saint Paul, Minn. In 1899 he became rector of Saint Francis' Church, Buffalo, Minn., and from 1902 until his death was rector of Saint Raphael's, Springfield, Minn. In 1893 he addressed the World's Parliament of Religions at Chicago on «The Primitive and Prospective Religious Unity of Mankind.» His published writings include the volumes 'Modern Scientific Views and Christian Doctrine Compared' (1884): 'Emmanuel: the Saviour of the World' (1888); 'Mediæval and Modern Cosmology' (1891).

GMELINITE, mĕl'-i-nīt (for Prof. Charles Gmelin), a native hydrous silicate of aluminum, calcium and sodium, crystallizing in the rhombohedral system, usually with a hexagonal aspect. It is colorless or white, often with tinges of yellow, green or red, and transparent to translucent, with a vitreous lustre. It is brittle, with a hardness of 4.5 and a specific gravity of about 2.1. It loses much of its water of crystallization when heated in a closed tube, and dissolves in hydrochloric acid, with separation of free silica. Gmelinite occurs in the Harz Mountains, in Cyprus and in parts of Italy and Ireland. It is also found at Cape Blomidon and at other points along the coast of Nova Scotia, and fine white crystals of it occur at Bergen Hill, N. J. The mineral was formerly called «hydrolite.»

GMÜND, Württemberg, town in the Rems Valley district, 30 miles southeast of Stuttgart. It has ruins of its former splendor as an imperial city. It contains a 14th century church, a monastery now used as a prison, a gymnasium, trade school and teachers' training school. It has manufactures of iron and wooden articles, cigars, flour, chronometers, jewelry, etc. It was an independent city until 1803. Pop. 21,000.

GNADENHÜTTEN, gnä'dĕn-hût-tĕn, **Massacre at.** For the westward retreat of the Delawares, and their partial conversion to Christianity by the Moravians, see under their name. In 1772 their Great Council settled the Christian Indians on the Muskingum in three villages, Salem, Schönbrunn and Gnadenhütten (Tabernacles of Grace), the latter being that of the Delawares. Through the Revolution these Indians as a body took no part in warfare, quietly cultivating their farms; but some of the younger ones joined the war-bands, which forced the Moravian villages to give them supplies and shelter. The whites were wrought to frenzy by these atrocities, in which they accused the Christian Indians of being secret participants; and in 1781 a successful foray against the hostiles was only prevented from involving the Moravians by the efforts of Colonel Brodhead. But the first blow against them was struck by the wild Indians and British. In the fall of 1781 Capt. Matthew Elliott, under orders from the British commandant at Detroit, with a body of white rangers and a miscellaneous horde of Indians from a half-dozen different tribes, forced them to leave their villages, which were half destroyed; the missionaries were taken to Detroit, and the Christian Indians left on the Sandusky plains, where the wild Indians would have massacred them but for the English. A few escaped and returned to the villages; they were captured by the Americans under Williamson, and taken to Fort Pitt, whose commandant, Gibson, their firm friend and attempted protector, sent them back to the villages unharmed. During the winter the rest suffered much from cold and hunger around Sandusky, and by the spring of 1782 some 150 had returned to the villages. Meantime the fiendish Indian outrages were going on; the borderers accused the Moravians of being privy to them, and denounced Gibson and Williamson for letting them go; and after a woman and child had been impaled alive by an Indian gang, who afterward refreshed themselves among the Moravians, the whites formed a party of near a hundred under Williamson to exterminate the latter. In March they gathered those in Salem and Gnadenhütten into two houses at the latter — those at Schönbrunn had been warned and escaped — under promises of good treatment; a council was held, at which 18 protested against the contemplated murder and withdrew, taking an Indian lad with them; the rest went in and killed the 96 inmates, after the latter had prayed and kissed each other farewell, only two other boys escaping. The best men of the borders denounced the cowardly butchery in unsparing language.

GNAT, năt, a somewhat indefinite term applies to various forms of small two-winged flies, especially those annoying to man and domestic animals. In England mosquitoes are known as «gnats,» but in America the term is more restricted to species of the genus *Simulium*, known also as «buffalo gnats,» «blackflies» and «turkey gnats,» or midges. One of the most remarkable of these species on account of its minute size is the so-called punky or «no see um» of northern woods. The buffalo gnat is quite as bloodthirsty as the mosquito, but is most annoying to domestic animals, which are frequently worried to death by swarms of these gnats. They differ from mosquitoes in that they are diurnal, while the latter normally fly by night. The larvæ of most of the gnats, with the exception of the gall and fungus gnats, are the aquatic and do no harm in this stage. There is also a distinctive form of gnats which occur throughout our country, but reach their highest development in the Gulf States. The common species are *Hippelates flavipes* and *H. plebjus*, which in Florida occur in great numbers, and are the direct cause of the disease «sore eye» which from time to time becomes epidemic in the rural districts.

GNAT-CATCHER, or **GNAT-SNAPPER,** any of various little birds that snap up minute insects on the wing. Specifically, in the United States, a small bluish-gray flycatcher (*Golioptila cærulea*), common from Maryland southward, and noted for the exquisite finish of its soft, lichen-covered nest, saddled upon a horizontal tree-limb. See Maynard, 'Birds of Florida' (1872).

GNATHOBDELLIDA, năth-ŏb-dĕl'li-dą, an order of leeches (q.v.), distinguished by the absence of a proboscis.

GNEISENAU, g'nī'sĕ-now, **August Wilhelm Anton,** Graf Neithardt von, Prussian field-marshal: b. Schildau, Saxony, 1760; d. 1831. He joined the German mercenary force which in 1782–83 supported the British cause in the American Revolutionary War, but returned in the following year. After taking part in the occupation of Poland, in 1793–95, he led a battalion at Saalfeld and Jena in 1806, and his defense of Kolberg in 1807 increased his military fame. Both as a member of the commission for the reorganization of the Prussian army, and as a commander at the battle of Leipzig (1813), he rendered valuable service, which he crowned by his successful direction of the Prussian force, as chief of staff under Blücher, in the campaign of Waterloo. Gneisenau was made governor of Berlin in 1818 and field-marshal in 1825. He died at Posen, while commanding the forces engaged in suppressing the Polish rebellion. Consult Pertz and Delbrück, 'Das Leben des Feldmarschalls Grafen Neithardt von Gneisenau' (5 vols., Berlin 1864–80).

GNEISS, nīs, a metamorphic rock, consisting usually of orthoclase, quartz and mica, though its composition is rather variable. It is akin to mica schist, but contains more orthoclase and less mica; it has the same components as granite, but is stratified or foliated or banded. The geological origin of gneiss is obscure. One theory is that gneiss is the result of the metamorphism of sedimentary rocks; on this hypothesis gneiss is closely related to conglomerate, which is a mixture of sedimentary pebbles and fine grains resulting from the action of water, while gneiss owes its foliated form to other causes. In some cases this sedimentary theory is undoubtedly true, but in others it is evident that gneiss is the production of eruptive forces, occurring, as it does, in purely igneous rocks. Gneiss is a convenient term for metamorphic foliated rocks, containing feldspar, the different varieties being named from some prominent mineral constituent, as *biotite* gneiss, *hornblende* gneiss, etc. In the United States, gneiss, in the ordinary usage of the term, is common, notably in New England and New York, the strata running northeast and southwest; and it is also common in Canada. It abounds in the mountains of central and northwestern Europe, in the peninsula of India and the Himalayas, and in the ranges of South America. Gneiss is used as a building stone and for flagging.

GNESEN, gnā'sĕn, Prussia, town in the province of Posen, 30 miles northeast of Posen. It contains an ancient cathedral, built in the Gothic style, which contains the remains of Saint Adalbert, bishop's palace, seminary, gymnasium, college, and manufactures machinery, lumber, leather, sugar, flour and dairy products. According to legend it was founded in 550 A.D., was made the seat of an archbishop in 1000 and was the capital of the Polish kings for a time in the Middle Ages. Pop. 25,000.

GNETALES. See Paleobotany.

GNOLI, nō'lē, **Domenico,** Italian author: b. Rome, 1839. Under the *nom-de-plume* "Dario Gaddi" he published a volume of poems and a collection of essays which attracted general attention. He became professor of Italian literature at Turin and was appointed prefect of the Biblioteca Vittorio Emanuele, Rome, in 1893. He wrote for *La Nuova Antologia,* and was one of the staff of *Archivio Storico dell' Arte.* He published several volumes of verse under the name of "Giulio Orsini." His other works include 'E. morto il re' (1882); 'Canto dei pellegrini alla tomba del gran re' (1883); 'Le opere di Donatello in Roma'; 'Il banco d'Agostino Chigi'; 'Jacovello' (1905).

GNOME, nōm (Gr. "judgment." "adage"), a short, pithy saying, often expressed in figurative language, containing a reflection, a practical observation or a maxim. Gnomes are a common form of early literature. In religious literature the proverbs of Solomon, those of Jesus, son of Sirach, and the Sermon on the Mount, are examples. The Sæmundian Edda has preserved excellent proverbs whose authorship it attributed to Odin. The word generally connotes Greek maxims or monitions, and Theognis, Phcylides and others are called the Gnomic poets, from their excellence in this sententious manner of writing.

GNOME, a name also given to certain humming-birds, among them the giant gnome (Patagonagigas).

GNOME ENGINE. See Internal Combustion Engine.

GNOME (nōm) **Owl,** one of the burrowing or "elf" owls of the American plains: specifically, Glaucidium gnoma.

GNOMES, in European folk-lore, spirits which dwell in the interior of the earth, where they watch over hidden treasure, and hence are the patrons of miners. Ugliness is their appropriate quality, though the females, gnomides, are beautiful. Among them all Rubezahl (Numbernip) has obtained, by means of Musäus' popular tales, the greatest celebrity in Germany. The native country of these poetical beings is the East, whence they were introduced into Europe between the middle of the 15th and the beginning of the 16th century by the cultivators of cabalistic philosophy, Pico of Mirandola, Marsilius Ficinus, Paracelsus, Cardanus and Reuchlin. The gnomes make a part of Pope's machinery in the 'Rape of the Lock.'

GNOMON, nō'mŏn, an astronomical instrument for measuring the altitudes and declinations of the sun and stars. It is usually a pillar or pyramid, erected upon level ground or on a pavement and is especially used for making the more important observations. Many have preferred it to the smallest quadrants, both as more accurate and more easily made and applied. The most ancient observation of this kind extant is that made by Pytheas, in the time of Alexander the Great, at Marseilles, where he found the height of the gnomon was in proportion to the meridian shadow at the summer solstice, as 213⅓ to 600. This method of observation was by no means accurate in ancient times, since observers did not take into account the sun's parallax, which makes his apparent altitude less than it would be if the gnomon were placed at the centre of the earth; they also neglected refraction, by which the apparent height of the sun is somewhat increased; and made their calculations as if the shadows were terminated by a ray coming from the sun's centre; whereas it is bounded by one coming from the upper edge of his limb. These errors, however, may be easily allowed for; and, when this has been done, the ancient observations are generally found to coincide nearly with those of the moderns.

Gnomon, *in geometry,* is the space included between the lines forming two similar parallelograms, usually squares, of which the smaller is inscribed within the larger, so as to have one angle in each common to both. The word gnomon is also used to designate an odd number; one of the terms of a series in arithmetic for the finding of polygonal numbers. See DIAL.

GNOSSUS. See CNOSSUS.

GNOSTICISM, nŏs'ti-sĭzm (Gr. γνῶσις, knowledge; γνωστικος, devoted to knowledge), the teaching of various sects in the first Christian century, who hovered on the borderland between Christianity and heathen thought. The systems they founded attempted to grapple with the most profound problems of philosophy, such as the creation of the world and the origin of evil. They taught that a series of divine emanations connected the Supreme Being with the visible universe; that human nature was dual and that the acts of the body had no influence on the spirit. They blent their ideas of Christian truth with pagan and Jewish elements, or even with those received from the common belief in magic. They taught that the earthly life of Christ was unreal, that is, He was a phantom and incorporeal, and they held that knowledge (γνῶσις), as they possessed it, was superior to faith.

Thus there was a general tendency to trace the same religious idea through different mythologies (which were held to be the popular expression of religious ideas originally revealed), and the new religion which aimed at the redemption of the whole world was eagerly seized on as the embodiment of their unifying principle. Christianity was believed to be the full revelation of the deeper truth embedded in all the nature-religions. By adapting their presentation of Christianity to the form of the ancient mysteries the Gnostic teachers the more easily fastened themselves upon the Christian congregations, and succeeded in taking up a position within them as specially initiated persons, for which they found a natural support in the prevalent ascetic views and the powerful influence of free prophecy. But these were in time forced to separate themselves and form sects, whose great diversity becoming the more apparent greatly counteracted, the influence of the Gnostic leaven in the Christian communities. To maintain their theories in the face of the traditional doctrine of the churches they had recourse to the sources of that doctrine. They claimed to have special traditions from certain of Christ's disciples, and applied their exegetical skill to the allegorical interpretation of the written monuments of the apostolic age. Marcion (about 150), believing himself to be a consistent follower of Paul, rejected the authority of the earliest apostles, as well as the gospels emanating from the circles of their influence, and professed to hold "the gospel" known to Paul only. His collection of 10 epistles of Paul was the first attempt to fix the canon of the apostolic Scriptures. Such arbitrary treatment of the Scriptures led the Church to resort to a more thorough study of the historical tradition. In the struggle with Gnosticism it obtained a firm hold of the principle that that alone is to be held true Christianity which can be shown to be historically derived from Christ and His apostles, and it found the only means to check the license of Gnostic speculation in the development of a Christian theology in accordance with the positive character of historical Christianity.

The general principles of Gnostic thought may be here summarized, as fuller accounts of the principal schools are given under their own names or under those of their founders. For the practical doctrine of the redemption of men's souls from sin by Jesus Christ the Gnostics substituted a speculative doctrine of the redemption of the human spirit from matter by religious knowledge. The realistic eschatology of the primitive Church they entirely set aside. The evangelic element in their teaching was obscured by a cloud of heathen mythologies and philosophic subtleties. The Divine Demiurgos and Lawgiver of the Old Testament was distinguished from the Supreme Being, and the Hebrew idea of creation was superseded by that of a continuous process of emanations from the divine first cause. The present world was believed to be the result of a catastrophe in which the spirit fell under the power of matter, or of an original destiny that powers hostile to God should bring into existence a world in which the spirit born of God should be held in unwilling estrangement from Him. All the Gnostic systems are more or less dualistic. In these dualistic theories a philosophical foundation was secured which was by the Gnostics developed to an extreme. The highest duty of man was to become united to the First Source of Spirit through *gnosis* and the absolute alienation of the human spirit from the body. Others, like Carpocrates and his son Epiphanes, expressed their contempt for the flesh and the ordinances of the Demiurgos in unbridled license. The contrasts of the flesh and the spirit and of the world and the kingdom of God are interpreted as the physical conflict of vast cosmic forces, and are thereby stripped of their moral and religious significance. The intervention of Christ is the crisis, not only of the religious history of mankind, but of the whole development of the universe. As the final and perfect Æon, He is distinguished from His visible manifestation. This is held to be: (1) a real human life with which He was connected for a time, or (2) a heavenly or "psychical" creation, or (3) a mere phantasm. Men are divided into two classes: the Pneumatic or "spiritual," who are constitutionally receptive of Christ's revelation and life everlasting, and the Hylic or "material," who are doomed to perish. Valentinians and others add a third, or intermediate class, the Psychical, or men of "soul," who are not capable of apprehending a divine revelation, but only of the popular faith (*pistis*), yet thereby may attain to a degree of knowledge and salvation.

The 'Pistis Sophia,' edited by Schwartze and Petermann (Berlin 1853), is the only

Gnostic work that has come down to us in a complete form, except those apocryphal Gospels and Acts of the Apostles which show a Gnostic tendency. Much of the system's tenets is learned from the writings and sermons of Irenæus, Hippolytus, Tertullian, Ignatius and Justin Martyr. Tatian's 'Diatessaron' was used in the Syrian Church down to the 5th century. The Gnostic Bardesanes of Edessa, one of the last of the Syrian Gnostics, was the founder of Syrian hymnology. See Bousset, 'Haupt probleme der Gnosis' (Göttingen 1911); Coxe, 'Ante-Nicene Fathers' (10 vols., New York 1885–96); Faye, 'Gnostiques et Gnosticisme' (Paris 1913); Mansell, 'Gnostic Heresis'; Neander, 'Genetische Entwickelung der vor Nehmsten gnostischen Systeme' (1818); Möller, 'Kirchengeschichte,' Vol. I (1889); Renan, 'Origines du Christianisme'; King, 'The Gnostics and their Remains' (1887); Hilgenfeldt, 'Ketzergeschichte des Urchristenthums' (Leipzig 1884); Harnack-Preuschen, 'Geschichte der altchristlichen Litteratur' (ib., 1893); Mead, 'Pistis Sophia,' translation (London 1896); Harnack, 'History of Dogma' (Vol. I, London 1894); Rainy, 'The Ancient Catholic Church' (New York 1902): Schmidt, C., 'Coptish-gnostische Schriften' (Leipzig 1905); Schultz, W., 'Dokumente der Gnosis' (Jena 1910).

GNOSTICS, a religious philosophical sect, who boasted of a deeper insight into the origin of the world, and of the evil of the world, than the human understanding, so long as it remains in equilibrium, can deem admissible, or even possible. Simon the magician, of whom Luke speaks in the Acts of the Apostles, was the first among them. Even in his dogmas we discover the traces of ideas which were common to all the Gnostics. They may be reduced to the following principal heads: The world and the human race were created out of matter by one æon, called the *demiurge,* or, according to the later systems of the Gnostics, by several æons and angels. The æons made the bodies and the sensual soul of man (*sensorium, psyche*) of this matter; hence the origin of evil in man. God gave man the rational soul; hence the constant struggle of reason with sense. What are called gods by men (for instance, Jehovah, the God of the Jews), they say, are merely such æons or creators, under whose dominion man became more and more wicked and miserable. To destroy the power of these creators, and to free man from the power of matter, God sent the most exalted of all æons, to which character Simon first made pretension; he was followed in these pretensions by Menander, a Samaritan, the most celebrated of his scholars, who, toward the end of the 1st century, founded a sect at Antioch in Syria. Simon and Menander were enemies to Christianity. Cerinthus, a Jew, of whom John the Evangelist seems to have had some knowledge, combined these reveries with the doctrines of Christianity, and maintained that the most elevated æon, sent by God for the salvation of man, was Christ, who had descended upon Jesus, a Jew, in the form of a dove, and through him revealed the doctrines of Christianity. In the 2d century, during the reign of Hadrian and both the Antonines, these principles were adopted by certain Christian philosophers, who are more particularly known under the name of Gnostics, and still further refined, extended and systematized. Saturninus, a Syrian, speaks of an unknown supreme God, who had generated many angels and powers; seven of these æons were, according to him, creators of the world, and soon fell from God; one of them, the God of the Jews, had seduced man to him, whence originated the difference between good and bad men. Saturninus also calls Christ the Saviour sent by God, and the Son of God; but the opinion that Christ was not actually born, and had not a real human body, but only an incorporeal image, is peculiar to him, on which account his followers and other later Gnostics who agreed with him in this respect were called *Docetæ* (from Greek δοκεῖν, to seem) and *Phantasiasts.* The system of Carpocrates, an Alexandrian, who also flourished during the reign of Hadrian, was distinguished from the one which we have just described in this respect only, that he considered Christ as a mere man, whose purer and more powerful soul had more accurately remembered what it had seen with God before its union with the body. The fathers of the Church, Clement of Alexandria, Irenæus, Eusebius and Epiphanius, from whom, in general, we derive all our information concerning the Gnostics, accuse the moral system of Carpocrates of destroying all distinctions between good and evil, and inculcating an unlimited indulgence of the sensual appetites. Certain it is that his followers practised the most detestable vices, and were the cause of many of the calumnies of the heathen writers concerning the Christians of this century. The Valentinian party, which rose toward the middle of the 2d century in Rome, and especially in Cyprus, and which was distinguished by its austere manners, was the most numerous of all the Gnostic sects, and continued until after the commencement of the 4th century. Marcion of Sinope, and Cerdo, a Syrian, renounced many of the absurdities of the earlier Gnostics, and formed a regular system, the characteristic of which was the rejection of the Old Testament. Bardesanes, a Syrian, and Hermogenes, an African, who in the reign of the Emperor Commodus, apostatized from Christianity and established sects, bordered, in their hypotheses concerning the origin of good and evil, upon Gnosticism. On the whole, when we take into consideration the philosophical tendency of that age, the passion for the marvelous that had taken possession of the effeminate nations of the Roman Empire, and the custom of pretending to a deeper insight into the secrets of nature and the divinity, it is not to be wondered at that a religious philosophy which adopted the most brilliant parts of Platonism, and which afforded nourishment alike to the imagination and to the vanity of secret wisdom, should have met with such universal success. By the austerity of its precepts, and its care for the well-being of the soul, it even prepossessed good men in its favor. The Gnostics were the Pietists of the 3d and 4th centuries. The Roman Catholic Church took occasion from their heresy to give greater precision to the articles of the orthodox faith. There have been no Gnostic sects since the 5th century; but many of the principles of their system of emanations reappear in later philosophical systems, drawn from the same sources as theirs. Plato's lively representation had given to the idea of the Godhead something substantial, which the Gnostics transferred to their æons; and Leibnitz's 'Effulgurations of God,' Ploucquet's 'Real Presentations of God,' Saint Martin's 'Pictures and Mirrors,' and the like, as well as the Gnostic æons, are a proof that the essays of the human understanding to explain the creation and the origin of imperfect beings from the perfect always end in similar results. See GNOSTICISM and works there referred to.

GNU, nū, a Hottentot name of one of the two species of wildebeest. The wildebeests are African antelopes, forming the genus *Connochetes*. The white-tailed gnu or "horned horse" (*C. gnu*) resembles, in form, partly the horse, partly the buffalo and partly the stag. It is as large as a middle-sized horse, and its neck is adorned with a stiff erect mane. On the forehead the face is covered with an oblong tuft of stiff black hairs, turned upward. Beneath the lower jaw is also a thick, shaggy beard. The legs are long and elegantly formed, like those of the stag; the space between the fore-legs is covered with long bushy hair. The tail is long and white. The horns are rough, and are enlarged at their base like those of the buffalo; they spring from the hinder part of the head, and, after bending forward beyond the eye, turn suddenly upward. Both sexes are furnished with these appendages. In the young animal they are perfectly straight, acquiring their flexure as the animal grows older. The gnu is affected by the sight of scarlet, like the buffalo or bull. When irritated, it expresses its resentment by plunging, curveting, tearing the ground with its hoofs and butting with its head. The flesh is juicy, agreeable and nourishing. This animal was formerly widespread and numerous, roving in small bands with zebras, etc.; but it is now nearly or quite extinct.

Another species, larger than above, and known as the brindled gnu, whose habitat was north of the Zambesi, has still escaped extirpation in the interior. It is named *C. taurinus*, and has no long hair in front between the fore-legs; there are dark stripes on the sides, and the tail is shorter and black. Consult Bryden 'Nature and Sport in South Africa' (London 1897); Lyddeker, 'Game Animals of Africa' (London 1908); Millais, 'A Breath from the Veldt' (1895); and the writings of South African sportsmen travelers from Gordon-Cumming (1850) onward.

GOA, India, a Portuguese colony on the Malabar coast. It comprises the capital, Panjin, and is about 60 miles in length and extends inland to an average distance of about 30 miles. The area is about 1,469 square miles with a population of 515,772. In 1917–18 the estimated revenue of the colony was 1,591,022 escudos ($1,018,254.08)* and the expenditure 1,810,977 escudos ($1,159,025.28).* It has a large transit trade, the imports in 1916 amounting to 3,550,984 escudos ($2,272,629.76)* and the exports to 1,209,009 escudos ($773,765.76).* The principal exports are cocoanuts, fish, fresh and salted, spices, caju-nuts, salt and copra. Goa was taken by Albuquerque in 1510 and has since been in the hands of the Portuguese.

GOA, India, city of the Malabar coast in the Portuguese colony of the same name, of which it was once the capital. It is the seat of a Catholic archbishopric, and is the primatial see of that Church in India. It contains a splendid cathedral, built early in the 17th century. In the early days of the colony Goa was a thriving city with a population of 200,000 souls, but about the beginning of the 18th century cholera epidemics became frequent and nearly all the Portuguese abandoned it and settled in Panjim, or New Goa, which has since then been the seat of the colonial administration. Consult Baden-Powell, B. H., 'The Villages of Goa in the Early Sixteenth Century' (London 1900), and Bruce, Henry, 'Letters from Malabar and on the Way' (New York 1909).

GOA, a Tibetan gazelle.

GOA POWDER, a substance found in the wood of the *Andira araroba*, a leguminous tree growing in Brazil and the West Indies. It derives its name from Goa, a Portuguese colony on the southwest coast of British India, to which it was imported from Bahia for the first time in 1852. It has a bitter taste, is considered efficacious in certain skin diseases and is used in the preparation of chrysarobin.

GOAJIRA, gō-ā-hē'rā, a peninsula in Colombia, which forms the most northerly point of South America. It lies west from the Gulf of Maracaibo, or Venezuela, and runs northeast from the Sierra Nevada de Santa Marta to the volcanic Sierra Macuira, which forms its apex, rising to a height of 2,800 feet. The coast is edged with sandbanks, but there is good anchorage at Bahia Honda. Its exports are dye-wood, dividivi, pearls and wood for cabinet work. Up to 1891 Venezuela laid claim to the peninsula, which in that year was formally ceded to Colombia.

GOAJIROS, gō-ā-hē'rōs, an Indian tribe inhabiting the peninsula of Goajira (q.v.), northwest of Lake Maracaibo, South America. They are reckoned at 30,000 souls, are subdivided into numberless septs or clans, and for the most part are nomadic, but engage in fishing and cultivate the soil and keep flocks and herds. They are skilful weavers, and trade in dividivi and fine woods. Their dwellings are rectangular in shape and built on piles in the mud in the little lagoons from which the country derived its name of Venezuela or "Little Venice." Their language is a branch of the Arowak and Maipure group, and connects them ethnologically with the aborigines of the Bolivian Andes and the plains of the Mahaica and Surinam rivers.

GOAT. There is probably no other domestic animal that is so widely distributed as the goat, yet there is none of them concerning which we have so little scientific information. There are 10 species of wild goats, all but one of which (the Rocky Mountain goat) are confined to Europe and the Himalaya Mountains. These 10 species are divided into two groups — the ibexes and the goats proper. The ibexes are composed of two sub-species — *Capra falconeri* and *Capra ægagrus*. The *C. ægagrus* is the Paseng, or Bezoar goat, or wild goat, of Persia, and is the progenitor of *C. hircus*, through which are descended all of the domestic goats of all countries. These are numerous in kind and variable in characteristics. Of these only the Angora and the Cashmere breeds and

(* Based on the averaged value of the *escudo* for 1917 ($0.64) its normal value is $1.09 American currency).

the several breeds of milch goats are of special economic importance, and these only will be treated here.

The Angora Goat.— The history of the Angora goat is traced to a distinctive breed even in the days of Abraham. This breed is a native of Angora, in Asia Minor. The geographical distribution of this breed is not extensive, their raising as an industry being confined to Turkey in Asia, South Africa and the United States. They have been transplanted to many of the European countries, but without successful result. Australia has had a small number for 50 years, but the industry there can hardly be regarded as important. A few Angoras are thriving in Canada and experiments are being conducted with them in Porto Rico and Cuba. Approximately stated, there are 3,700,000 of these goats in Turkey, 5,000,000 in South Africa and 800,000 in the United States. At this time they may be found in every State and Territory, including Alaska.

Angoras were introduced into the United States from Asia Minor in 1849 by Dr. James B. Davis, of Columbia, S. C. The war scattered or destroyed nearly all that were in the Eastern and Southern States, but the few that had found their way to California and the Southwest increased rapidly in numbers by crossing upon the long-haired Mexican goats. The redivivus of the industry came about the year 1900, when it was discovered that this country not only had the mills to consume all of the mohair of domestic production, but was also importing over a million pounds annually. The organization in the same year of the breeders into a registry and fair association gave to the industry its first impetus; and then the government assisted largely in exploiting the qualities of the animals. About this time, too, the ability of goats for destroying brushwood became widely known. These two leading features have tended to bring about a rapid growth of the industry.

The Angora goat is small, weighing generally from 60 to 100 pounds, although many may be found in the United States that weigh as much as 140 pounds, and occasionally one much heavier than this. Males and females alike have horns and beards, except that in rare instances one without horns may be seen. The horns of the male grow to a length of 18 to 20 inches and turn upward, outward and backward, while those of the female, which grow to a length of 8 to 10 inches, grow upward and point backward with only a slight inclination to twist. The ears are usually medium long and pendant, but there are frequent specimens having ears that are short, pointed and pricked. Except in rare instances, the fleece is pure white, growing to an annual length of 10 inches and covering the entire body down to the knees and hocks. There is no goat odor with this breed except with the bucks at rutting time. The Angora usually has one kid at a birth; two are not uncommon, and three are seldom dropped.

The uses of the Angora goat in the United States are three: (1) For the production of mohair (see MOHAIR); (2) for the production of meat; and (3) for the destruction of brushwood and weeds. It is used rarely as a milch animal, owing to the uncertain quantity of milk which it yields.

The uses of mohair are many, and the demand has stimulated the breeding of animals of better quality. The average weight of the fleece at this time is about three pounds, but there are many animals of exceptional merit that will yield 12 pounds and even more and occasionally a flock that will average five pounds per head. The goats yield heavier fleeces in the colder parts of the country than in the warmer sections; and those animals taken from the southwestern States to the northern part of the United States show an increase the first year.

The Angora is the only one of the numerous breeds of goats that yields a carcass that is edible at all ages. The Angora kids, like those of other breeds of goats, are considered a delicacy, and the mature animal is free from the strong taste that is characteristic of other breeds. The size, shape and quality of the Angora carcass make it to resemble so much that of the sheep that the packers slaughter large numbers of the low grade Angoras and sell them as sheep mutton. A peculiarity of Angora mutton is that it requires a longer time for cooking than does sheep mutton. In the southwestern part of the country, especially on the large ranches, where it is difficult to keep meat fresh, many grade Angoras are slaughtered for food; but in other parts of the country, where the animals are usually of high grade, they are not generally slaughtered, being regarded as of more value for mohair production.

The predilection of goats for brushwood and weeds is characteristic of all breeds, but the Angoras are employed principally for this use because they are able to produce a marketable fleece at the same time they are cleaning up the land. In many parts of the United States they are regarded as of more value for clearing brushland than as mohair producers. This is especially true where the land cleared is suitable for raising large crops or growing vigorous orchards. The total area of land so cleared of brushwood by these goats aggregates many thousands of acres, and their work is done in a most satisfactory manner. The goats first eat every twig and leaf within their reach while standing on their hind legs, seldom making any choice as to species of tree, and later, if not given new pasture, will peel the bark from the saplings. If they are again placed upon land the second year, so that they may destroy the sprouts that put out from the stumps, their work will be completed, for the stump and roots then die. As the brushwood and weeds are destroyed and the sunlight thus permitted to reach the soil, the grass, if any variety is indigenous to the locality, will soon be observed to spring up and thereupon spread rapidly. Where a good variety is not indigenous, a common practice is to sow the seed. This method insures a grass pasture sooner than depending upon the natural grasses and their natural distribution over the cleared area. The goats prefer browsing upon the brushwood to feeding upon the most luscious grasses and clovers and will give the latter very little attention if there is enough of the former to satisfy their hunger. Their presence upon the soil and their indirect assistance in producing the pasture do not make the grass objectionable in any way to horses, cattle or sheep. It should be stated, however, that goats will thrive upon

1 Angora Goat — Young Doe

2 Angora Goat — Buck

grass and clover if it becomes necessary, and there is no better rough feed for them in winter than clover hay.

The Cashmere Goat flourishes in Kashmir, in India, whence it receives its name, and in Tibet. Its color is usually white, and in many other ways it resembles the Angora; but its heavier and outer coat is coarse and not of economic value. Its under coat, called pashm, is very fine and light in weight, and brings very high prices. The amount of pashm produced by each goat annually is between two and three ounces. Most of this fibre is secured by combing the animals when it loosens from the skin, but a considerable amount is picked from the bushes where the animals have rubbed in an effort to remove the sloughing hair. The famous Cashmere shawls, which, a half century and more ago sold at $100 to $2,000, were made of pashm. Dr. Davis brought one Cashmere doe to the United States with his Angora flock in 1849; a buck of this breed died on the voyage. Nine others came in the Brewer importation about 1858. The Cashmeres appeared not to be able to survive the climatic conditions to which they were subjected here, and at this time there is probably not a single specimen in this country.

Milch Goats.— No one has attempted to state how many breeds of milch goats there are in the world; one writer says that there are no less than 16 in Switzerland. They are found in all European and Asiatic countries and in northern Africa.

In May 1904 there was an importation of 26 Toggenburg and Saanen goats from Switzerland into the United States, and they are thriving well in Massachusetts, New York, New Jersey and Maryland. So far as any records show, these are the only goats of pure blood that have been received, except four that came in 1893, which did not thrive well; but it is believed that a few kids of Italian goats have been brought here by immigrant families from Italy, and that these have matured and been crossed with the common goats that are usually found in the suburbs of the large cities, thus lending something of their milk characteristics to these latter goats. It is not difficult to find good milkers among these common goats.

A good milch goat should have the same leading characteristics that are possessed by a milch cow. The goat should be level on the back, with slightly dropping hips; the hair, whether long or short, should be kept trimmed close on the udder; the udder should have a shriveled appearance immediately after milking, and the teats should be long and slim.

Milch goats are prolific, seldom having fewer than two kids at a birth, and sometimes four of them. If not restrained they will breed three times in two years.

The quantity of milk that they give varies; a goat that will give two quarts of milk daily for six months is a good milker, but there are many of the best breeds that will yield four quarts a day with a lactation period of six to nine months. Thus it will be seen that, when body weight is considered, the goat is a larger producer of milk than the cow. The milk has a slightly different taste from that of the cow; the strong, acrid taste so often noted by those who have drunk it is due to unclean methods of milking. If the milk is drawn perfectly clean and kept clean, it does not have either taste or smell that is offensive. It is highly regarded in the Old World for its health-giving properties and as a food for children. It is used quite largely in the hospitals in the Swiss and French Alps for tuberculous patients and for those suffering from stomach troubles.

Kids that are not to be kept for breeding are disposed of for slaughter, and there is a good demand for them among certain classes in the large cities. The flesh is exceedingly delicate, and nothing but the prejudice of people against a matter which they have not tested prevents a larger production and consumption of kids. The kids should be from one to two months old when slaughtered, as after two months the flesh begins to grow tougher and stronger.

Common Goats.—According to the census report of 1910 there are 2,915,000 goats and kids in the United States, a gain of over 60 per cent in a decade. Their breeding can hardly be referred to as an industry, for they have thrived and increased in numbers in spite of neglect. They have been useful in an incidental manner only. A considerable number are used as pets for children, and occasionally a fair milker is found among them. Since the Angoras have demonstrated the ability of the goat to destroy brushwood, the common goats have been brought together in flocks in some localities and there employed also as brush destroyers. Most of them are in the West South Central division of the United States.

Goat-skins.— In normal seasons there is a considerable importation of goat-skins for glove-making, coming chiefly from British India, Mexico, Germany, Russia and Brazil. As much as $30,000,000 worth have been imported in a single year, and many persons have thought that the goat-skin industry ought to be developed in the United States, since we have here all that is desirable in the way of climatic, soil and market conditions. This is doubtful, however, since in all of the countries where the skins are produced in large quantities the wages of goat-herds is a mere pittance, and the carcass is consumed for food. These two features seem to preclude a large goat-skin industry in this country. Goat-skins are used in the manufacture of shoes, gloves, music rolls, morocco for book bindings, etc. The skin of the Angora goat is used as rugs and robes with the hair intact, and also for children's muffs, capes and for boas.

George Fayette Thompson,
Bureau of Animal Industry, Washington, D. C.

GOAT-ANTELOPE, a term applied to certain small mountain-climbing ruminants, which in structure and habits are intermediate between typical goats and antelopes. Such are the white goat of the Rocky Mountains; the chamois of Europe; and the gorals, serows, etc., of the Himalayan and other Oriental mountain regions. For description see their English names.

GOAT-FISH, one of the gaudy and edible fishes, allied to the surmullets, of the genus *Upeneus,* which abound in the West Indies and Gulf of Mexico, and take their popular name from a fancied likeness of their bearded profile to a goat's. There are several species. The

English sometimes call their filefish (q.v.) by this name.

GOAT ISLAND, (1) an island in the Niagara River which separates the Horseshoe and American falls. (2) A large island in San Francisco Bay, where there is a lighthouse and government station.

GOAT-LOUSE, a parasite living in the hair of goats. It is a biting louse of the genus *Trichodectes,* and that which infests the Angora goats (*T. limbatus*) is often troublesome. Various species occur in various parts of the world.

GOAT-MOTH, a large European malodorous moth (*Cossus ligniperda*), whose caterpillar, the "auger-worm," feeds upon decayed wood, boring a tunnel at the end of which, after three years of growth, it forms a cocoon of chips gummed together by a secretion, and transforms within it.

GOATSBEARD, a small rosaceous plant of American woodlands (*Aruncus aruncus*), closely allied to spiræa, with minute white flowers in dense panicles blooming in June, in rich woods of the Mississippi Valley; and also on the northern Pacific coast and in Europe and Asia. The name is also given to a saxifrage (*Astilbe biternata*), and to dandelions of the genus *Adopogon* and some other plants.

GOATSUCKERS, a family of birds, defined under *Caprimulgidæ,* so erroneously named that the term should be abandoned. See NIGHTJAR; NIGHTHAWK; WHIPPOORWILL, etc.

GOBAT, gō-bä', **Samuel,** English missionary: b. Bern, Switzerland, 26 Jan. 1799; d. Jerusalem, 11 May 1879. After completing a course in Oriental languages in the Mission House at Basel, he became a missionary, going to Abyssinia in 1826 for the English Church Missionary Society. In 1829 he had reached Gondar, but in 1832, upon the outbreak of war in that part of the country, he returned to England. In 1834 he made another journey to the same country, but owing to illness again had to go home. In 1839 he was sent to Malta, where he worked on a translation of the Bible into Arabic and had charge of the presses there, and in 1845 was appointed a director of the Protestant College. In 1846 Friedrich Wilhelm IV of Prussia placed him in charge of the joint Lutheran and Anglican see of Jerusalem, an appointment which he held until his death. It was in the orphan schools and hospitals of Jerusalem, Nazareth and other cities of Palestine that he did his greatest missionary work. He wrote 'A Journal of Three Years in Abyssinia' (1847). A translation of his biography by Rovrich appeared in London in 1884.

GOBELIN (gŏb'lăṅ) **MANUFACTORY,** a tapestry manufactory at Paris, established by Colbert in 1667. The Gobelin tapestries excel everything of the kind in Europe. Many celebrated paintings of the Italian, French and Spanish schools have, in the most marvelous manner, been transferred to tapestry. Among the more celebrated of these may be mentioned the portrait of Louis XIV, by Rigaud (the original of which is in the Louvre); 'The Assumption' of Titian, a large work, 23 feet in height; a head by Nicholas Poussin, copied by Marie Gilbert, etc. The first two of these are to be seen in the Gobelin Gallery. All are characterized by splendor of coloring and delicacy of execution. The establishment is now carried on at the expense of the government.

GOBI, gō'bē, **Desert of,** China, the Shamo, or "sand-sea" of the Chinese, an immense tract of desert country, occupying nearly the centre of the high tableland of eastern Asia, between lat. 35° and 45° N., and long. 90° and 110° E., and extending over a large portion of Mongolia and Chinese Turkestan. Its length is probably about 1,800 miles; mean breadth, between 350 and 400 miles; area, 300,000 square miles. Its general elevation is over 4,000 feet above sea-level. It consists of mountains, tablelands and dreary wastes of sand. The rainfall is slight and the climate is very severe. The East Gobi is occupied by different tribes of the Mongolian race, who have numerous herds of camels, horses and sheep. In the West Gobi are some nomadic tribes of the Tartar race. This tract is supposed at one time to have been a great inland sea. Several caravan routes lie across the desert from China proper to Siberia. Most of the inhabitants are Buddhists. Marco Polo alludes to Gobi, but the Jesuit Gerbillon was the first to give definite information concerning it, having crossed it several times in 1688–98. Subsequently it was explored by Ysbrand Ides in 1692–94, and by Lorenz Lange in 1727–28 and 1736. Within the last half century accurate information has been furnished by various explorers, notable among whom are Przhevalski and Sven Hedin.

GOBIN, Hillary Asbury, American educator: b. Terre Haute, Ind., 25 March 1842. In 1862–65 he was in the Union army, was graduated from Indiana Asbury College (the present DePauw University) in 1870, was admitted a licensed preacher of the Northwest Indiana Conference of the Methodist Episcopal Church, and held various pastorates in Indiana. In 1880–86 he was professor of the Greek language and literature at DePauw, in 1886–90 president of Baker University (Baldwin, Kan.), in 1890 became dean of the theological faculty at DePauw. Member of the General Conference, Omaha 1892, Cleveland 1896, Chicago 1900 and Minneapolis 1912, and member Ecumenical Conference, London, England, 1901. President of DePauw from 1896 to 1903. Vice-president since 1903. His writings comprise articles and reviews in religious and secular periodicals.

GOBINEAU, gō-bē-nō, **Joseph Arthur,** COUNT DE, French diplomat and author: b. Bordeaux, 1816; d. Paris, 17 Oct. 1882. He served in the French diplomatic corps in the various capitals of Europe, at Athens in 1868, at Rio Janeiro, South America, and at Stockholm. Chief among his writings are 'Troi ans en Asie' (1859); 'Les religiones et les philosophies dans l'Asie centrale' (1865); 'Histoire des Perses' (1869), etc.

GOBLET, gō-blā', **Albert Joseph,** Belgian soldier and statesman: b. Tournai 1790; d. 1873. He participated in the battle of Waterloo, and after the Revolution became Minister of War, remaining in that position until he was made Minister of Foreign Affairs in 1832. In 1837 he was appointed Ambassador of Spain, a post he held for two years, and it was then that the title of Count d'Alviella was bestowed upon him by the queen of Spain. In 1843 he was again appointed Minister of Foreign Affairs, and for two years in this capacity his influence on all public matters was felt to a marked degree. He also planned the fortification along the frontier of northern Belgium, and extended those already built around Antwerp. He wrote 'Des cinq grandes puissances de l'Europe dans leurs rapports politiques et militaires avec la Belgique' (1863); 'Dix-huit mois de politique' (1865), etc.

GOBLET, D'Alviella Eugène, COUNT, Belgian archæologist and religious historian: b. 1846. He became professor of the history of religions at the University of Brussels, afterward being elected a Liberal member of the Belgian Chamber of Deputies. In 1892 he was elected to the Senate. After traveling through the Sahara Desert he began his writings, the more important of which are 'Sahara and Lapland' (1875); 'Inde et Himalaya'; 'The Contemporary Evolution of Religious Thought in England, America and India' (1885); 'The Migration of Symbols' (trans. Sir George Birdwood 1894); 'Ce que l'Inde doit à la Grèce' (1897); 'Croyances, Rites, Institutions' (3 vols., 1911).

GOBLET, René, French statesman: b. Aire-sur-la-Lys, 26 Nov. 1828; d. Paris, 13 Sept. 1905. He practised law at Amiens, and entering in 1871 the National Assembly, identified himself with the left Republican group, and became known as an orator, particularly through his part in the discussion respecting the revision of the pension-list for officials under the empire. In 1882 he became Minister of the Interior, in 1884 of Education and in 1885 of Education and Public Worship. Prime Minister in 1886–87, he was Minister of Foreign Affairs in 1888–89, was elected senator in 1891 and sat in the Chamber of Deputies as a Radical in 1893–96.

GOBY, gō'bĭ, any one of the 400 species of fishes belonging to the family *Gobiidæ*. They are small carnivorous animals, occurring chiefly on the bottoms of tropical seas and ponds. Most of the species have the ventral fins united into a sucking disc. Most interesting of the gobies are the mud-skippers (*Periophthalmus*) of the western Pacific, which hop about the shores by aid of their pectoral fins, feeding upon insects and naked mollusks. Many of the gobies make nests for their eggs.

GOCH, gōн, **Johannes von** (proper name, JOHANN PUPPER), German monk, precursor of the Reformation: b. Goch, Prussia, about 1400; d. Mechlin, 28 March 1475. He was educated at Cologne. All that is known of his subsequent life is that he established an order of canonesses at Mechlin in 1451, that he attempted to introduce reforms in the convents there and for 24 years acted as father confessor of the deaconesses at Thabor. He was a man of great piety and in his day was compared with à Kempis as a theologian. In his writings he demanded that the Bible should chiefly be explained by itself and laid great stress on love, piety and on evangelical freedom. His principal works are 'De Libertate Christiana' and 'Dialogus de quator erroribus circa legem evangelicam exortis.' Consult Clemen, 'Johann Pupper von Goch' (Leipzig 1896) and Ullman, 'Reformers before the Reformation.'

GOD, the Supreme Being, the First Cause, and as considered nowadays throughout the civilized world, a spiritual being, self-existent, eternal and absolutely free and all-powerful, distinct from the matter which he has created in many forms, and which he conserves and controls.

There does not seem to have been a period of history where mankind was without belief in a supernatural author and governor of the universe. The most savage nations have some rudimentary ideas of God. Man is a religious as well as a rational animal. The instinct of belief in God is asserted by philosophical theists to be reconcilable with reason, although no competent apologist now stakes the existence of God on any one argument, or exhibits the proof as a series of syllogisms. It is rather maintained that the study of human history, of human nature especially on its moral and spiritual side, and of the world as far as science reveals it to us make for the existence of a God, demand such a postulate as the key to the universe, and render the belief in a personal God greatly more probable than any other thesis — a subject vastly too wide for discussion here. But it is necessary to name what are often referred to as the four great arguments for the existence of God.

(1) The *ontological* argument first formulated by Saint Anselm proceeds from the notion of a most perfect being to infer his existence; without actual existence the idea would fall short of perfection. The argument was restated in a different shape by Descartes (q.v.) and by Samuel Clarke, and though very contemptuously treated by Kant, is still an element of the argument that without a God the world is a chaos.

(2) The *cosmological* argument, employed by Aristotle, Aquinas and a host of Christian authors, is an application of the principle of causality. We cannot conceive an infinite regression of finite causes; therefore beyond the last or first of the finite causes is the Infinite. From motion the argument is to a mover.

(3) The *teleological* argument, or argument from design, proceeds from the order and arrangement of the universe, the reign of law and beauty and adaptation, to the intelligent and supreme fountain of order. This is the most familiar of the arguments, especially on the lines laid down by Paley. Kant was the first of the moderns to object to this mode of proof. He was followed by Mill and Spencer, whose objections are based upon the relativity of knowledge, which renders a conception of a Supreme Being essentially unintelligible. The more popular objection against the idea of God is that because it is incapable of proof, — of such proof as is given to the propositions of science.

(4) The *moral* argument was that relied on by Kant (q.v.) when he destructively criticized the other three, and forms a part of most modern theistic arguments. God is a postulate of our moral nature; and the moral law in us implies a lawgiver without us.

Consult Adeney, 'The Christian Conception of God' (New York 1912); Clarke, 'The Christian Doctrine of God' (ib. 1909); Fiske, 'Through Nature to God' (Boston 1899); Martineau, 'Study of Religion' (Oxford 1888); 'The Idea of God' (Boston 1887); Flint, 'Theism' (1877); Harris, 'The Philosophical Basis of Theism' (1883); 'The Grounds of Theistic

and Christian Belief' (1883); the Duke of Argyll, 'The Reign of Law' (1890); Kant's 'Critique of Pure Reason'; Mill's 'Three Essays'; Janet's 'Final Causes' (trans. 1878); Gifford Lectures (1888); Orr, 'Christian View of God and the World' (London 1897); Ronayne, 'God, Knowable and Known' (1898); Driscoll, 'Christian Philosophy — God' (1902); King, 'The Development of Religion' (New York 1910).

GOD, Name of, in Different Languages, may be seen from the following list: Elohim, Hebrew; Gott, Swiss and German; Eilah, Chaldaic; Goed, Flemish; Eleah, Assyrian; Godt, Dutch; Alah, Turkish and Syraic; Alla, Malay; Goth, Teutonic; Allah, Arabic; Gude, Danish and Swedish; Teut, old Egyptian; Teun, new Egyptian; Gude, Norwegian; Teuti, Armarian; Bogo, Polish; Theos, Greek; Bung, Polacca; Jubinat, Lapp; Sire, Persian; Magatal, Tartar; Deus, Latin; Diex, Latin, low; Diu, Gallic; Dieu, French; Dios, Spanish; Deos, Portuguese; Diet, Old German; Diou, Provençal; Doue, low Breton; Dio, Italian; Dia, Irish; Deu, Olala tongue; Thios, Cretan; Jumala, Finch; As, Runic; Fetiyo, Zemblian; Istu, Pannonian; Rain, Hindostanee; Brama, Coromandel; Prussa, Chinese; Goezur, Japanese; Zannah, Madagascar; Puchecammæ, Peruvian.

GOD SAVE THE KING (or **QUEEN**), the burden and common title of the English national anthem. Concerning the author and the composer opinions differ. It has been asserted that Henry Carey, who lived about the middle of the 18th century, was both; but, being ignorant of the rules of composition, employed Dr. Thornton, of Bath, or, according to some, Christopher Smith, Handel's clerk, to correct his rough draught, and add the bass. This story gave rise to the assertion that Handel was the composer. The words and music were first published in *Harmonica Anglicana* in 1742 and reprinted in the *Gentleman's Magazine* in 1745, when the landing of the young Stuart called forth expressions of loyalty from the adherents of the reigning family. After Dr. Arne, the composer of «Rule Britannia,» had brought it on the stage, it became very popular. According to a notice in the *New Monthly Magazine*, Vol. IV, page 389, there is a copy of this national song, published without date by Riley and Williams, in which Antony Young, organist in London, is called the author of the air. There is also a story that this national song, as Burney, the author of the 'History of Music,' maintained, was not made for King George; but that, in the older versions, it ran thus, «God save great James our king»; and Burney adds, that it was originally written and set to music for the chapel of James II, but that no one dared own or sing it after the abdication of James, so that the song lay dormant 60 years before it was revived for George II. Another account ascribes the air to John Bull, who was organist to the chapel of Queen Elizabeth in the last years of her reign. Translated by Heinrich Herries in 1790, it was adapted by G. B. Schumacher as the Prussian national anthem. The American hymn, 'My Country, 'Tis of Thee,' is set to this tune. Consult Bateman on 'National Anthems' (*Gentleman's Magazine*, Vol. 275, 1893); Hadden, 'God Save the Queen Myths' (*Argosy*, Vol. 72, 1900); Cummings, 'God Save the King' (1902). See NATIONAL HYMNS.

GODAVARI, gō-dä'vą-rē, a large river in southern India. Its source is in the western Ghauts, about 70 miles northeast of Bombay, and flows southeast into the Bay of Bengal. Its total length is 900 miles; its drainage basin has an area of 112,000 square miles. About 50 miles from the sea the river runs down to the sea through a wide alluvial delta formed by masses of silt deposited by the river, and into which canals have been cut. Its principal tributaries are the Parna, Pranhita, Indravati, Manjera and Maner. In respect to scenery, utility to man and sanctity, this river is surpassed only by the Ganges and the Indus.

GODDARD, Arabella (Mrs. J. W. DAVISON), English pianist: b. Saint Servan, Brittany, 12 Jan. 1836. At eight years old she had lessons from Kalkbrenner in Paris and subsequently studied under Mrs. Anderson, Thalberg and J. W. Davison in England. She made her début at the Grand National Concerts at Her Majesty's Theatre in 1850 and was the first pianist to play Beethoven's posthumous sonatas in Great Britain. In 1854–55 she went on a concert tour of Germany and Italy, receiving great acclaim in Leipzig, where she appeared at the Gewandhaus Concert in 1855. In 1873–76 she toured through America, Australia, India, Java and China and took part in Sir Arthur Sullivan's concerts at the Paris Exhibition of 1878. In the same year she retired from public life.

GODDARD, Calvin Luther, American inventor: b. Covington, N. Y., 22 Jan. 1820; d. 1900. He was graduated from Yale in 1845 and subsequently devoted his attention to the invention of labor-saving contrivances employed in the wool industry. Among his various inventions of this character may be cited feed rolls for carding machines, a burring picker for the purpose of cleansing wool and solid packing burring machines. He was the recipient of many medals for his inventions and improvements in the handling of raw cotton, among them a special gold medal from the London World's Fair (1862) and the Paris World's Fair (1867).

GODDESS OF REASON. In 1793, during the Revolution in France, several officials of the new régime proclaimed the suppression of all religious worship and invited the clergy to abjure their errors. Fouché, at Nevers, was the first who set out to suppress the clergy and to convert sacred objects into either money or bronze for cannon. A great number of the clergy, including Gobel, metropolitan of Paris, came forward and abdicated their sacred functions. To take the place of the old cult the Convention proclaimed the feast days of the Goddess of Reason. Notre Dame was dedicated to her and a solemn celebration took place there 10 Nov. 1793. An actress of the Opera, Mlle. Maillard, took the part of the goddess. She was received by the Convention whence she marched in procession to her temple and there was enthroned on the high altar, while the people sang the Hymn of Liberty. Similar celebrations were held at divers places throughout the country, but the new worship declined under Robespierre and Notre Dame was restored to Catholic worship in 1802.

GODEFROI, gōd'frwä, **Michael M.**, Dutch jurist: b. Amsterdam, 13 Jan. 1814; d. Würzburg, 27 June 1882. Devoting himself to jurisprudence, his abilities soon attracted attention and in 1846 he became judge of the Provincial Court for North Holland, and in 1848–81 was elected member of the States-General. In 1860 he prepared a new code of judicial practice and procedure and in the same year became Minister of Justice. A defender of the rights of the people, he labored none the less to promote Jewish emancipation in Switzerland, Rumania and elsewhere, insisting in exhaustive addresses that no commercial treaties should be ratified with any country until guarantees be given that Netherland Jews receive equality before the law in that land.

GODERICH, gōd'rich, Canada, capital of Huron County, Ontario, port of entry, on Lake Huron at the mouth of the Maitland River, on the Grand Trunk and Canadian Pacific railways, 133 miles northwest of Toronto. It has a good harbor, steamship lines to various ports, and its people trade largely in fish, salt and lumber. It is in a good farming district, lumbering and boat-building are important industries, its fisheries are extensive and large salt-wells make salt-refining one of its chief industries. There are also manufactories of foundry products, machinery, organs, knitting machines, woolen, leather, boots and shoes, woodenware, etc.; flour and saw mills; and large grain elevators. Pop. (1911) 4,522.

GODESBERG, gōds'bĕrg, Prussia, a village of the Rhine Province, on the Rhine, near Bonn. It contains mineral springs to which great numbers have recourse annually. In the vicinity lie the ruins of the castle of Godesberg, erected in the 13th century and destroyed by the Bavarians in 1583. The village has extensive brickyards and large quilting establishments. Consult Dennert, 'Godesberg, eine Perle des Rheins' (Godesberg 1900). Pop. 10,600.

GODET, gō-dā', **Frédéric**, Swiss theologian: b. Neuchâtel, Switzersland, 25 Oct. 1812; d. 1900. After having been tutor to the Crown prince of Prussia, he became in 1850 professor of theology at Neuchâtel. In 1873 he left the state Church and was appointed professor by the Free Church of Neuchâtel. He is best known for his great commentary on Saint John's Gospel (1863–65; Eng. trans. 1877), followed by commentaries on Luke (trans. 1875), Romans (trans. 1881), and Corinthians, besides 'Conférences Apologétiques'; 'Etudes Bibliques' (trans. as 'Old Testament Studies and New Testament Studies,' 1875–76); 'Introduction to Paul's Epistles' (1893).

GODETIA, a genus of plants of the Evening Primrose family, containing about 30 species, natives of western North and South America, especially of California. The plants are annuals with narrow leaves and spikes of large, showy, rose, purple or white flowers. *G. amœna*, the best known species, sometimes known as farewell-to-spring, and *G. grandiflora* are common in cultivation.

GODEY, Louis Antoine, American publisher: b. New York, 6 June 1804; d. Philadelphia, 29 Nov. 1878. He was educated in his native city. He founded the periodical, *Godey's Lady's Book*, the first women's periodical in the United States, at Philadelphia, in 1830, and continued its editor and proprietor until its sale to a stock company in 1877. His other publications included 'Jarvis' Musical Library,' the *Young People's Book* and the *Daily Chronicle*.

GODFATHER and **GODMOTHER** (also, in infant baptism, called sponsors), the persons who, by presenting a child for the sacrament of baptism and taking upon themselves the vows of faith and obedience, as proxies for the child and in the name of the child, are reputed to contract toward the newly baptized the relation of spiritual parentage. In the Roman Catholic Church this spiritual relationship is regarded as a species of kindred (whence the name *gossip* or *God-sib*, «spiritually akin»), and constitutes an impediment of marriage between the sponsors upon the one hand and the baptized and the parents of the baptized on the other. Anciently, this impediment arose between the sponsors themselves; and it still extends much further in the Eastern than in the Western Church, although in the former it can arise only from baptism, whereas in the Roman Church the candidate for confirmation also is presented by a sponsor, though usually one of the same sex.

In the Church of England, by whose rule two godfathers and a godmother are required at the baptism of a male, and two godmothers and a godfather at that of a female, no impediment of marriage arises from the relation of the sponsors to the baptized. The parents of the baptized are not permitted to act as sponsors in the Roman Catholic Church, one of the objects of the institution being to provide instructors in case of the death of parents; but the rubric of the American Prayer-book does so allow.

The institution of sponsors was very ancient, and Tertullian (192 A.D.) speaks of the promises made by sponsors in baptism. In the early Church no more than one sponsor was required, a man for a man and a woman for a woman. In adult baptism, the godfathers and godmothers are not sponsors, but only «chosen witnesses,» as the person to be baptized takes the vows himself and in his own name.

GODFREY, Thomas, American mathematician and mechanician: b. Bristol, Pa., 1704; d. Philadelphia, December 1749. He was a glazier in his native city; but accidentally meeting with a mathematical treatise, was delighted with the study, mastered all the books on the subject that he could obtain and instructed himself in Latin in order to read mathematical works in that language. He borrowed a copy of Newton's 'Principia' from James Logan, secretary of the Commonwealth, and in 1730 communicated to him an improvement that he had made in the quadrant. In 1732 Logan gave an account of the invention to Dr. Edmund Halley of England, in a letter. No answer was received after an interval of a year and a half, and then the invention of Godfrey was laid before the Royal Society by the botanist Peter Collinson. Meantime, in 1731, John Hadley, vice-president of the Royal Society, had presented a paper containing a full description of an improvement of the quadrant similar to that of Godfrey. The rival claims were investigated by the Royal Society, aud it was decided that both men were entitled to the honor of the invention. The society bestowed on Godfrey a reward of household furniture valued at £200, instead of money, on account of his intemperate habits.

GODFREY, Thomas, American poet, son of Thomas Godfrey, mathematician: b. Philadelphia, Pa., 4 Dec. 1736; d. near Wilmington, N. C., 3 Aug. 1763. He is remembered as being the author of 'The Prince of Parthia' (1759). a tragedy, considered to be the first drama published in the United States. In 1763 appeared 'The Court of Fancy; a Poem,' modeled somewhat upon Chaucer's 'House of Fame,' and in 1767 his poems were collected in a volume by his friend, Nathaniel Evans.

GODFREY OF BOUILLON, boo-yôn', king of Jerusalem: b. Baisy, in the Walloon Brabant, near Nivelles, about 1058; d. Jerusalem, 15 July 1100. In 1076 he succeeded his uncle in the duchy of Bouillon. He distinguished himself by his heroic courage at the siege of Rome, and the fame of his exploits procured him, in 1095, the command of one of the armies of the first Crusade. In 1096 Godfrey, with his brothers Baldwin and Eustace, commenced his march to Constantinople, the meeting-place of the crusading armies. So great had been the difficulties of the way that it was only a short time before Christmas when he reached Constantinople. Here new delays occurred. The Emperor Alexius Commenus would not consent to allow the Crusaders to cross into Asia Minor until the leaders had sworn to give up to him all the lands which they should conquer which had previously belonged to the Roman Empire, and to remain his faithful vassals for all time coming. This Godfrey at first indignantly refused to do, but after a long course of hostilities finally yielded to the demands of Alexius. On 1 May 1097 they crossed the Bosporus, and before the end of the year the Crusaders encamped before Antioch. The town fell into their hands on 3 June 1098, but the citadel held out much longer. In the following year (15 July 1099) Godfrey took Jerusalem itself, after a five weeks' siege. The infidels were indiscriminately massacred, notwithstanding the endeavors of Godfrey to put a stop to the slaughter. Eight days after the capture of Jerusalem the leaders of the army elected him king of the city and the territory; but Godfrey declined the kingly title on the ground that it would not be becoming for him to «wear a crown of gold where his Saviour had worn one of thorns,» assuming that of baron and guardian of the holy sepulchre. The sultan of Egypt now raised an army of 400,000 men for the purpose of expelling the Crusaders, but Godfrey decisively defeated him in the plain of Ascalon. This victory placed him in possession of nearly all the Holy Land. Godfrey now turned his attention to the organization of his newly established government, dying just a year after the capture of Jerusalem. He was buried in the church of the Holy Sepulchre.

GODFREY OF STRASSBURG. See GOTTFRIED OF STRASSBURG.

GODHAVN, gŏd'hävn, or **LIEUELY,** Greenland, on the south coast of Disco Island. It is the capital of the Danish Northern Inspectorate. Pop. 300.

GÖDING, gė'ding, Austria, town in Moravia, on the March, 70 miles northeast of Vienna. It is the seat of an imperial castle surrounded by a great park, both of which are prime objects of interest to visitors. The town's industrial establishments include sugar-refining works, distilleries, a brewery, saw mills and a tobacco factory. There are also cavalry barracks and horse depot and two high schools, one for Czechs and one for Germans. Pop. 10,230.

GODIVA, gō-dī'vạ, a legendary English heroine. She was the wife of Leofric, Earl of Mercia and Lord of Coventry in the reign of Edward the Confessor. The inhabitants of Coventry having on one occasion offended their master, he punished them by inflicting so heavy a fine that they were unable to pay it. In their distress they appealed to Lady Godiva to intercede for them, saying that if they paid the fine they must starve. Godiva, sympathizing with the people, went to her lord to plead that, for her sake, the tax might be remitted. Leofric, when she persisted in her entreaties, at last said half jocularly and half contemptuously, that he would grant her request if she would ride naked through the town of Coventry. Having first received permission from her lord to fulfil the condition imposed Godiva caused it to be made known on what terms the earl had agreed to relieve the people from the tax, and then proclaimed that on a certain day no one should leave his house before noon, that all windows and other apertures in the houses should be closed and that no one should even look out until noon was past. She then mounted naked on her palfrey, rode through the town and returned; and Leofric, in fulfilment of his promise, and in admiration of his wife's heroism, freed the inhabitants from the burdens he had imposed on them. Only one person, the story says, attempted to look out, and he was immediately struck blind. The incident is commemorated by a stained glass memorial in Saint Michael's Church, Coventry. A mediæval pageant celebrating Godiva's ride was a feature of Coventry fair for several centuries, and recen attempts to revive the pageant have been made. Consult Tennyson's 'Godiva'; and Harris's 'Story of Coventry' (London 1911).

GODKIN, Edwin Lawrence, American journalist and essayist: b. Moyne, Ireland, 2 Oct. 1831; d. England, 20 May 1901. He was graduated from Queen's College, Belfast, in 1851, and subsequently was correspondent during the Crimean War for the London *Daily News* (1854–56). He came to the United States as correspondent of that journal and after some time spent in travel was admitted to the New York bar in 1858. During the Civil War period he corresponded both for the *Daily News* and the New York *Times,* and in 1865 established *The Nation,* which was merged with the New York *Evening Post* in 1882. He continued to edit both papers from that date until shortly before his death. He published a 'History of Hungary' (1856); 'The Problems of Modern Democracy'; 'Reflections and Comments'; 'Unforeseen Tendencies of Democracy' (1898). He was an able, forceful writer who often strenuously opposed dominant political tendencies or principles, but whose entire conscientiousness was never disputed. Under his management the *Post* and the *Nation* acquired a great influence over the more thoughtful members of the community. His conception of public office as a public trust helped mold the best political theories of the time. He condemned the «spoils» or close party system in American politics, and «boss» and «machine rule» in all its forms. His fearlessness in exposing corruption often exposed him to abuse and misunderstanding. In 1890 during an election campaign in New York he published with editorial comment a series of biographies of Tammany leaders, which led to his being prosecuted for criminal libel. The charges were dropped, however. In 1897 he received the degree of D.C.L. from Oxford University, and in 1903 a memorial Godkin lectureship was founded at Harvard dealing with the duties of the citizen and the essentials of free government. Consult Ogden, R., 'Life and Letters of E. L. Godkin' (New York 1907).

GODLESS MONTH, the 10th month of the year with the Japanese, so called by them because then the lesser divinities were considered to be absent from their temples for the purpose of paying the annual respects to the celestial Dairi, a word which, in Japanese, means «the Great Interior,» that is, of the imperial palace, and in a general sense the person of the Mikado, whose title, «King of Heaven» or «Son of Heaven,» implies his divine right to such homage.

GODMAN, John D., American naturalist and medical writer: b. Annapolis, Md., 1794; d. Germantown, Pa., 17 April 1830. He was graduated at the University of Maryland in 1818. In 1813 he entered as a sailor in the flotilla then stationed in Chesapeake Bay, but in 1815 left the service, and commenced the study of medicine. After lecturing for some time at Baltimore in the room of the professor of anatomy in the University of Maryland, and holding a chair of anatomy for a short time at Cincinnati, he settled in Philadelphia as a physician and private teacher of anatomy. In 1826–27 he was professor of anatomy and physiology in Rutgers Medical College in New York, and was one of the editors of the Philadelphia *Journal of Medical Science*. His chief work is his 'American Natural History' (1828). He also wrote 'Anatomical Investigations'; 'Account of some Irregularities of Structure and Morbid Anatomy'; 'Rambles of a Naturalist,' etc.

GODMOTHER. See GODFATHER.

GÖDÖLLÖ, gė-dėl'lė, Hungary, a market town 15 miles north by east of Budapest. It contains a royal castle, which since 1867 is the royal summer residence. It is surrounded by magnificent grounds in which a great royal hunting party is held annually. The town contains a school for instruction in operating hand looms. Windischgrätz, the Austrian general, was defeated here by Görgey, the Hungarian commander, on 6 and 7 April 1849. Pop. 5,890. Consult Ripka, 'Gödöllö' (Vienna 1898).

GODOLPHIN, Sidney, 1ST EARL OF, English statesman: b. near Helston, Cornwall, June 1645; d. Saint Albans, 15 Sept. 1715. He was an opponent of James, Duke of York, and a supporter of Shaftesbury during the exclusion agitation, but nevertheless continued in office after the accession of James II. On the flight of that monarch, Godolphin voted for a regency, yet was, after the settlement of the crown on William and Mary, made first commissioner of the treasury. During the reign of Anne he was appointed lord high-treasurer of England, and did much to improve the public credit, and check corruption in the administration of the public funds. In 1706 he was made Earl of Godolphin, and four years afterward was obliged to retire from office.

GODON, Sylvanus William, American naval officer: b. Philadelphia, 18 June 1809; d. Blois, France, 10 May 1879. Appointed midshipman in 1819, he was active in the Mexican War, and in the Civil War, in command of the *Mohican*, with rank of captain, took part in Du Pont's attack on Port Royal (1861). In 1863 he was promoted commodore and in 1864–65 commanded the fourth division of Porter's fleet in the attacks on Fort Fisher. Having commanded the South Atlantic squadron in 1866–67 and the Brooklyn navy yard in 1868–70, he was retired in 1871 with rank of rear-admiral.

GODOWSKI, gó-dŏv'skē, **Leopold,** Polish-American pianist: b. Vilna, Russian Poland, 13 Feb. 1870. A pupil of the Hochschule of Berlin and afterward of Saint-Saëns, he made concert tours in the United States in 1884–85 and 1890–91. In 1895–1900 he was director of the pianoforte department of the Chicago Conservatory, to which post he was again appointed in 1902. In 1909 he accepted the office of director of the piano-teacher's school at Vienna. His compositions include concert arrangements of well-known works, concert studies, etc.

GODOY, gō-dō'ē, **José Francisco,** Mexican diplomat and author: b. Tampico, Mexico, 9 Aug. 1851. He studied law, was admitted to the bar in California and practised in the United States and Mexico. He was also active as a journalist. He entered the diplomatic career in 1888; was chargé-d'affaires and then Minister in Central America; several times chargé-d'affaires in Washington, D. C., and Minister from 1907 to 1914 in Cuba, where he became dean of the diplomatic corps. He represented Mexico at the San Antonio International Fair (1889 and 1890); at the World's Columbian Exposition in Chicago (1893) and at the Pan-American Exposition of Buffalo (1901) and was one of the secretaries of the Second Pan-American Conferences held at Mexico City (1901–02) and at other gatherings of importance. He has written various works in English and Spanish and lately made a successful Spanish version of ex-Ambassador Gerard's 'My Four Years in Germany.'

GODOY, Manuel, DUKE OF ALCUDIA, Spanish noble: better known as the Prince of Peace: b. Badajoz, 12 May 1767; d. Paris, 4 Oct. 1851. He entered the Guards in 1787 and was admitted to the presence of the queen, whom he at once captivated by his handsome person and pleasing manners. The imbecile king, Charles IV, was as much pleased with him as his spouse and he was thus established as a favorite. In 1795, as a reward for the part he had taken in concluding peace with France, he was presented with a large landed estate and made a knight of the Golden Fleece. It was on this occasion also that he was named by the king Prince of Peace. Other honors and largesses continued to shower upon him, till at last the whole power of the Spanish monarchy was concentrated in his hands. As he used it in the promotion of French rather than Spanish interests, he became extremely unpopular and an outbreak took place in 1808. He in consequence sought an asylum in France, where he employed the influence which he still possessed over the Spanish king to induce him to abdicate in May 1808. Notwithstanding the enormous wealth which he had at one time accumulated, he lived a long time in Paris in poverty, maintained chiefly by a small pension from Louis Philippe. He was the author of a work published in a French translation made under his supervision (1836–38) under the title of 'Mémoires du Prince de la Paix, Don Manuel Godoy, due de l'Alcudia.'

GODS, Roman and Greek. The following are among the more prominent gods in Roman and Greek mythology:

Gods	Greek	Roman
King of Gods	Zeus.	Jupiter.
God of Water	Poseidon.	Neptune.
God of the Lower Regions	Pluto.	Pluto.
Messenger of the Gods	Hermes.	Mercury.
God of War	Ares.	Mars.
The Gods' Smith	Hephæstos.	Vulcan.
God of Light	Apollon.	Apollo.
Goddess of Hunting	Artemis.	Diana.
Goddess of Wisdom	Athene.	Minerva.
Queen of Heaven	Hera.	Juno.
Goddess of Tillage	Demeter.	Ceres.
Goddess of the Hearth	Hestia.	Vesta.
Goddess of Beauty	Aphrodite.	Venus.
God of Wine	Dionysos.	Bacchus.
God of Love	Eros.	Cupid.
God of Time	Chronos.	Saturn.
Wife of Chronos	Rhea.	Cybele.
Queen of Hades	Persephone.	Proserpina.
Goddess of the Rainbows	Iris.	Iris.
Cup-bearer to the Gods	Hebe.	Hebe.

See Greek Gods; Greek Mythology; Mythology.

GOD'S TRUCE, a mutual agreement between territorial nobles confirmed and sanctioned by the Church by which war and violence were to be abstained from for a certain period. In the 9th and 10th centuries the empire of Charlemagne had become broken up into small territories, dukedoms, baronies, counties. The right of private war was a settled principle of the times and dissensions were frequent and bitter. The peasantry and farmers especially were sufferers from the ravages of this petty warfare. Even the monasteries, cathedral colleges and seats of learning were not left in peace and everything threatened anarchy and dissolution. It was at this point that the Church stepped in, as the minister of justice and the guardian of moral order. Stern ecclesiastical penalties were fulminated against all who in the reckless feudal warfare should disturb the peace of churches, priests and tillers of the soil. The Truce of God was instituted and by its provisions no fighting men should go forth to war on certain days. The little border province of Roussillon was the place where this truce was first agreed upon in the year 1027. Fourteen years later the movement had spread over the whole of France and later it extended to Germany, Italy, Spain and England. The Truce of God in 1041 provided that peace was to last from Wednesday evening to Monday morning of each week; there was to be no war during Advent and Lent nor on certain specified saints' days and holy days; the punishments for contumacy and disobedience were money fines, banishment for a long term of years and excommunication; protection was specially extended to all women, pilgrims, priests, travelers, merchants and agriculturists and also to the farm implements and live stock of the peasantry. The Peace of God was confirmed by several councils of the Church, more especially by that of Clermont (1095), when Urban II proclaimed its universal extension throughout Christendom. In spite of its high ecclesiastical sanctions, the peace was often broken with impunity. The centralizing of power in strong kingships, which took place in the 13th century, naturally led to the more speedy subjugation of internal wars.

GODTHAAB, gŏt'häb (Danish, "Good Hope"), Greenland, seaport, on the west coast, capital of the Danish Southern Inspectorate. It is the oldest town in Greenland and was founded in 1721 by Hans Egede, a Norwegian missionary. Pop. 950.

GODUNOFF, gô-dọ'nŏf, **Boris Feodorovitch,** Russian tsar: b. 1552; d. 13 April 1605. He was the chief member of the regency during the reign of the imbecile Feodor Ivanovitch (1584–98) who had married Godunoff's sister Irene. In 1589 he was largely instrumental in effecting the separation of the Russian Church from the patriarchate of Constantinople. He also issued a ukase forbidding the transference of peasants from one proprietor to another. He was accused of having caused the death of the Tsarevitch Demetrius in 1591, but in 1598, upon the death of Feodor, was elected to the throne. In 1591 he had defeated the Khan of the Crimean Tartars; in 1595 he recovered territory that had been lost to Sweden and he recolonized Siberia. His policy was in the main progressive, but much popular discontent, especially in southern Russia, was caused by the favors shown by him to foreigners and by his introduction of numerous innovations and reforms.

GODWIN, or **GODWINE,** Earl of the West Saxons, an Anglo-Saxon noble: b. about 990; d. 1 April 1053. Godwin became the leading Englishman in the first half of the 11th century and was father of the last king of the English native stock. He ingratiated himself with Ulf, brother-in-law of King Canute, the latter gave him his daughter in marriage and he soon became one of the most powerful of the English nobles. He was the most powerful factor in procuring the English throne for Edward the Confessor and from that time headed the national party (1042) in opposition to the Norman court favorites. His son Harold (afterward king) was Earl of East Anglia; his son Swegen was Earl of Hereford, Gloucester and Oxford; his wife's nephew, Beorn, was Earl of Hertfordshire and Buckinghamshire; and for the service he had rendered to the king Edward had married his daughter Editha. This union, however, was not happy. Editha was cruelly neglected by Edward, and her father, by his dislike of the Normans, incurred the royal enmity. A quarrel afterward arose between the king and Godwin, occasioned by the partiality of the former for Norman favorites and Godwin in consequence headed a rebellion, but was compelled to submit and with his family was banished from the kingdom (1051). His estates were confiscated and then given to favorites. Queen Editha was made to feel even more bitterly the misfortunes of her family. Her husband seized her dower; he took from her her jewels and her money; and allowing her only the attendance of one maiden, he closely confined her in the monastery of Wherwell, of which one of his sisters was lady-abbess. In September 1052, however, Godwin returned with an army, forced Edward to enter into negotiations with him, re-established himself triumphantly in his old supremacy and caused the expulsion from the kingdom of most of the Norman intruders.

GODWIN, Francis, English bishop and author: b. Hanington, Northamptonshire, 1562; d. 1633. He was graduated from Christ Church, Oxford, in 1581; took orders and became successively rector of Sampford Dorcas in Somersetshire, vicar of Weston-in-Zoyland and subdean of Exeter in 1587. In 1601 appeared his 'Catalogue of the Bishops of England,' a work which procured him the bishopric of Llandaff from Elizabeth. Revised editions of this work appeared in 1615 and in 1616 with a dedication to King James I, who in 1617 transferred him to the bishopric of Hereford. Godwin also wrote 'Rerum Anglicarum Henrico VIII, Edwardo VI, et Maria regnantibus, Annales' (1616–28, later published as the 'Annales of England'); 'Nuncius Inamatus in Utopia' (1629); and 'The Man in the Moon, or a Discourse of a Voyage Thither, by Domingo Gonsales' (1638).

GODWIN, Mrs. **Mary Wollstonecraft,** English writer, wife of William Godwin (q.v.): b. (place uncertain) 27 April 1759; d. London, 10 Sept. 1797. Her father was Edward John Wollstonecraft, son of a wealthy manufacturer of Spitalfields, London. Her mother was Elizabeth Dixon, an Irish woman. The brutality of her father made Miss Wollstonecraft's home life almost unbearable; and when their mother died in 1780 she and her two sisters left their father's house. One of these sisters married a Mr. Bishop. He proved not less brutal than her father, drove her into hiding and forced her in 1783 to obtain a legal separation. The misfortunes of Mrs. Bishop, however, provided Miss Wollstonecraft with material for her posthumous unfinished novel 'The Wrongs of Women.' From 1783 to 1785 Miss Wollstonecraft conducted with this sister a school at Newington Green. From this work she went to Lisbon to nurse a friend, Fanny Blood, with whom she had lived from 1780 to 1783 and who had since married a merchant, Hugh Skeys. The death of this friend, from childbirth, 29 Nov. 1785, suggested to Miss Wollstonecraft a pamphlet entitled 'Thoughts on the Education of Daughters.' This pamphlet was accepted by Johnson the publisher, and so opened the way for a remunerative business connection. In 1788, after an unpleasant year as governess in the family of Lord Kingsborough, Miss Wollstonecraft removed to London and found employment with Johnson. In the five years that followed, she worked for him as reader and translator, published the first and only volume of her 'Vindication of the Rights of Women' (1792), and made the acquaintance of many literary people, among whom was the man she afterward married, William Godwin. Her interest in the principles of the French Revolution led her in 1792 to Paris. There she met Gilbert Imlay, a former captain in the American Revolution. Without the formality of a marriage, which both professed to disapprove, they lived as man and wife, and to them, at Havre, 14 May 1794, was born a daughter. Next year Miss Wollstonecraft followed Imlay to England. He sent her to Norway on business connected with his commercial speculations and took the opportunity to carry on an intrigue with another woman. Returning, she first attempted suicide by drowning; then, reconciliation with Imlay. Finally, in March 1796, she agreed to a separation. Her resumption of literary work brought her again in contact with William Godwin. Despite her experience with Imlay, she, like Godwin, still objected to a legal marriage. At length, however, both set aside their scruples and on 29 March 1797, they were married. Mary, the future Mrs. Shelley, was born 30 August. The mother, however, died of a fever a few days after — 10 Sept. 1797. In her memory her husband published the following year 'Memoirs of the Author of a Vindication of the Rights of Women.' Her works include 'Thoughts on the Education of Daughters' (1787); 'Vindication of the Rights of Men' (1790); 'Vindication of the Rights of Women' (1792); 'Historical and Moral View of the French Revolution' (1794); 'Letters Written in Norway, Sweden and Denmark' (1796); 'Posthumous Works' (1798).

Bibliography.— Godwin, William, 'Memoirs' (1798); 'A Defense of the Character and Conduct of the Late Mary Wollstonecraft Godwin,' anon. (1803); Paul, C. Kegan, 'William Godwin, His Friends and Contemporaries' (1876); and 'Mary Wollstonecraft, with Prefatory Memoir' (1879); Taylor, R. G. S., 'Mary Wollstonecraft' (1911).

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GODWIN, Parke, American journalist: b. Paterson, N. J., 25 Feb. 1816; d. New York, 7 Jan. 1904. He graduated at Princeton College in 1834 and having studied law in his native town was admitted to practise in Kentucky, but did not pursue the profession. From 1837 to the close of 1853, with the exception of one year, he was the coadjutor of his father-in-law, William Cullen Bryant (q.v.), in the editorial management of the New York *Evening Post.* In 1843 he issued for a time the *Pathfinder,* a weekly periodical of a literary and political character. While connected with the *Evening Post* he contributed frequently to the *Democratic Review* and he also edited *Putnam's Magazine* for a time. He translated some of Zschokke's tales and the first part of Goethe's autobiography. Other works of his are 'A Popular View of the Doctrines of Charles Fourier' (1844); 'Democracy, Constructive and Pacific' (1844); 'Vala, a Mythological Tale' (1851); 'Handbook of Universal Biography' (1851); 'Political Essays' (1856); 'History of France' (1st vol., 1861); 'Cyclopædia of Biography' (1865); 'Out of the Past' (1870), essays which he had contributed to *Putnam's Magazine;* 'Biography of William Cullen Bryant' (1883); 'A New Study of the Sonnets of Shakespeare' (1900).

GODWIN, William, English writer and political philosopher: b. Wisbeach, Cambridgeshire, England, 3 March 1756; d. London, 7 April 1836. He attended various schools and in 1771 became an usher in that of Robert Akers at Hindolveston. The next year his father, John Godwin, a dissenting minister, died, and in 1773 William removed with his mother to London, where he entered Hoxton Academy. Four years later he began preaching and between 1777 and 1783 he was minister at Ware in Hertfordshire, at Stowmarket in Suffolk, and, for a brief trial, at Beaconsfield.

Unsuccessful as a minister, he turned in 1783 to literary work. In the 10 years that followed he supported himself — not over-successfully — by hack work, made many friends, especially among Whig politicians and sympathizers with the French Revolution and formulated those radical opinions which he embodied in his 'Political Justice' (1793). He had for some years been satisfied, he says in his Preface, "that monarchy was a species of government essentially corrupt." He owed this conviction to the political writings of Swift and to a perusal of the Latin Historians. Nearly at the same time he derived much additional stimulus from several French productions on the nature of man — the 'Systême de la Nature,' the works of Rousseau and those of Helvetius. The work, he says, "was projected in the month of May, 1791; the composition was begun in the following September, and . . . occupied a space of 16 months." The book appeared in February 1793, when England was at a white heat over the execution of Louis XVI and the French declaration of war against England and Holland. Godwin feared, not without cause, that he would be prosecuted for such a publication; but the government seems to have judged that a book costing three guineas would prove harmless. The book met immediate success, running through three editions within five years; but its author, repenting the radicalism of the first edition, made the second and third editions increasingly moderate. Godwin's political philosophy attracted wide attention; and although he never again attempted so large a subject as in his 'Political Justice,' yet he continued to have a following, especially among young men. Of these, a few years later, Shelley is a notable instance.

Godwin's first and ablest novel, 'Caleb Williams,' appeared one year after 'Political Justice' (1794). The story, although since ridiculed by DeQuincey, enjoyed high success at the time. 'Saint Leon, a Tale of the 16th Century' (1799), was also successful. Meanwhile, in 1796, Godwin had become intimate with Mary Wollstonecraft, then known as Mrs. Imlay. Both held that a legal marriage was undesirable; but, lacking the courage of their conviction, they were married 29 March 1797. Mrs. Godwin died 10 September after giving birth to a daughter, the future Mrs. Shelley. Four years later, having been rejected by at least two other women, Godwin married a Mrs. Clairmont. The union brought unhappiness and financial difficulties. In 1805, his wife undertook a publishing business. Under the name of Baldwin, he wrote children's books for her; and the Lambs gave them their 'Tales from Shakespeare.' By 1807, increasing business warranted a removal to a larger shop in Skinner street, Holborn. Godwin's circle of acquaintances included Coleridge, the Lambs, and Wordsworth. In 1811, the young Shelley was added. When, however, in 1813, Shelley put some of Godwin's moral theories into practise by eloping with Mary Godwin, the philosopher was enraged. A check for £1,000 silenced him. When Shelley and Mary were married, three years later, Godwin was openly reconciled. He had need of the financial countenance of so wealthy a son-in-law. The publishing business was becoming less remunerative. In 1822, Godwin became bankrupt. Literary and political friends tried to aid him, but succeeded only in part. In 1833 they secured him the position of yeoman usher of the exchequer — an office without duties. He died 7 April 1836. Nine years later, DeQuincey wrote of him: "Godwin's name seems sinking out of remembrance; and he is remembered less by the novels that succeeded, or by the philosophy that he abjured, than as the man that had Mary Wollstonecraft for his wife, Mrs. Shelley for his daughter, and the immortal Shelley as his son-in-law."

His works include 'Enquiry Concerning Political Justice and its Influence on Morals and Happiness' (1793); 'Things as they are; or the Adventures of Caleb Williams' (1794); 'The Enquirer . . . a series of Essays' (1797); 'Memoirs of the Author of a Vindication of the Rights of Women' (1798); 'Saint Leon, a Tale of the 16th Century' (1799); 'Antonio, a Tragedy in Five Acts in Verse' (1800); 'Life of Geoffrey Chaucer' (1803) 'Lives of Edward and John Philips' (1815); 'Mandeville, a Tale of the 17th Century' (1817); 'Of Population . . . in answer to Mr. Malthus' (1820); 'History of the Commonwealth . . . to the Restoration of Charles II' (4 vols. 1824–28).

Bibliography.— C. Kegan Paul's 'William Godwin, his Friends and Contemporaries' (2 vols., 1876).

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GODWIN-AUSTEN, Henry Haversham, English topographer and geologist: b. Teignmouth, 6 July 1834. He is the son of R. A. C. Godwin-Austen, the distinguished geologist; was educated at the Royal Military College, Sandhurst; joined the 24th Regiment of Foot in 1851; in 1852 went with his regiment to India and served with distinction in the Second Burmese War and in the Punjab. He then became topographical assistant in the Trigonometrical Survey of India in 1857, and joined the Kashmir Survey party. While connected with this he surveyed a large part of Kashmir and Baltistan and discovered the enormous glaciers at the head of the Shigar River and Hunza Nagar frontier, including the important Baltoro glacier. In 1862 he surveyed the Rupshu and Zaskar districts in Ladakh during July and August of that year, making 13 ascents of mountain peaks, the highest of which was Mata, 20,607 feet. He then surveyed the Pang Kong Lake district nearly to Rudok in Chinese territory, but was stopped in 1863 by the Lhassan governor; during the winter of 1862–63 was on special duty with the last mission to Bhutan, and mapped out the country between Darjeeling and Bunakha. In 1874 he served with the Bhutan Field Force, and was present at the capture of Dalmgkote and Chamurchi forts; took part in the expedition against the

Dafia tribe in the eastern Himalayas; and in 1877 was retired from the army with the rank of lieutenant-colonel. From 1897–99 he was president of the Malacological Society, and in 1908 president of the Conchological Society. He was awarded the founder's medal of the Royal Geographical Society in 1910. Mount Godwin-Austen has been named in his honor. Besides numerous scientific papers on geology and physical features he has written 'On the Land and Freshwater Mollusca of India' (1882–99), in parts, and the volume on mollusca in 'The Fame of British India.'

GODWIN-AUSTEN, a mountain peak said to be exceeded in height only by Mount Everest, in the Mustagh range of the Himalayan system. Its height is estimated at 28,265 feet. Distinguished in the records of the great trigonometrical survey only by the sign K2, it was named in 1888 after H. H. Godwin-Austen (q.v.) of the Trigonometrical Survey of India.

GODWITS, a group of wading-birds allied to the sandpipers but with longer legs and bill, and distinguished from curlews by the straight not decurved bill. They constitute the genus *Limosa*, of which five species are known. All of them are summer residents of the northern part of the northern hemisphere, but on their migrations reach northern Africa and South America, while one species extends its flight to New Zealand. They are noted for their loud, yelping cries. Their plumage is of a pale dull chestnut red barred and varied with black. The females are larger than the males, but most common American species are the marbled godwit (*L. fedoa*), and the Hudsonian godwit (*L. hæmastica*), both known to gunners as "marlin." The marbled godwit is from 16 to 22 inches long, nests chiefly in the interior from Iowa north to the Saskatchewan, and winters in Cuba and Central and South America. It is rare on the coast. In England two other species occur — the black-tailed godwit (*L. ægocephala*) — which formerly bred in the fens, but the netting by sportsmen, with the reclamation of these areas, has made it only a summer visitor; and the bar-tailed godwit (*L. lapponica*), a bird of passage, which has been known to breed as far north as Iceland.

GOEBEL, gō'bĕl, **Julius**, American university professor: b. Frankfort-on-Main, Germany, 23 May 1857. He studied at the University of Leipzig in 1879–81, and received the degree of D.Ph. at Tübingen in 1882, in which year he migrated to the United States. In 1885–88 he was instructor in German at Johns Hopkins, and from 1892 to 1905 was professor of Germanic philology and literature at Leland Stanford Junior University. From 1905 to 1908 he lectured on Germanic philology at Harvard, and since 1908 has been professor of Germanic languages at the University of Illinois. In 1888–92 he served as editor of the *Belletristisches Journal*, and since 1909 has been editor of the *Journal of English and Germanic Philology*. He is the author of 'Ueber die Zukunft unseres Volkes in Amerika' (1883); 'Ueber tragische Schuld und Süne' (1884); 'Gedichte' (1895); 'Das Deutschtum in den Vereinigten Staaten' (1904); 'Der Kampf um deutsche Kulture in Amerika' (1914). He edited 'Goethe's Poems' (1901); 'Goethe's Faust' (1907); 'Schiller's Poems' (1903). Since 1909 he has been general editor of the German Classics, in Oxford University Press Series, and since 1913 of the 'Yearbook of the German American Historical Society.' He is a contributor to the *American Journal of Philology, Modern Language Notes, Anglia, Goethe-Jahrbuch*, etc.

GOEBEL, William, American public official: b. Carbondale, Pa., 1854; d. 3 Feb. 1900. In 1866 his family removed to Covington, Ky. He was educated at Gambier College and the Cincinnati Law School. Soon after his admission to the bar he became law partner of Gov. John G. Stevenson in 1875, and of John G. Carlyle in 1886. He became prominent in cases directed against large corporations and was widely known as a friend of the people. He was elected State senator from Kenton County in 1888, and was re-elected for every term up to 1900. Prominent among the laws sponsored by him are that making gambling a felony; the granting to second-class cities the right to erect and maintain free public libraries and that creating a State Electoral Commission. He was one of the nominees for governor in 1899 and a bitter campaign ensued. Taylor, the Republican candidate, was inaugurated, but the election was contested by Goebel and, on 30 Jan. 1900, a test vote in the legislature showed that he would be seated. Goebel was shot that very day while on his way to the capitol. A majority of both houses now declared Goebel governor and the oath of office was administered to him. Three days later he died and was succeeded by Beckham, who had taken the oath of lieutenant-governor. Consult Powers, Caleb, 'My Own Story' (Indianapolis 1905).

GOEBEN, gė'bĕn, **August von**, German military officer: b. Stade, Hanover, 1816; d. Coblentz, 1880. In 1837 he served in the Carlist army in Spain, and afterward returned to Prussia, where he entered the military service in 1842. As colonel in 1860, he was attached to the Spanish army during the war with Morocco. In 1864 he took part in the campaigns against Denmark, and two years later in the war with Austria, in which he became general of infantry. As commander of the Eighth Corps in 1870 he took part in the battles of Forbach, Gravelotte and Saint-Privat. Sent into northern France he fought at Pont-Noyelle and Bapaume, and won a great victory at Saint-Quentin on 19 Jan. 1871. He wrote articles in military journals on the campaigns in which he had taken part and 'Vier Jahre in Spanien,' an account of his sojourn in Spain.

GOEBEN and BRESLAU, German warships, respectively the fastest armored vessel in the German navy (22,640 tons; 28 knots) and a fast light cruiser (4,478 tons; 27 knots), both of great coal capacity. At the outbreak of the European War these vessels were cruising off the Algerian coast in the Mediterranean. It is supposed that when they received their first sailing orders either the assistance of Italy or the neutrality of England was reckoned upon by Germany, and that these vessels should in the one case assist Italy and Austria against France and Great Britain, or in the other Austria against France. They began operations by firing some shots into the unprotected Algerian coast towns of Philippeville and Bona, then, turning northwest, apparently intended to make for the Atlantic via the Straits of Gibraltar. They were headed off by the British fleet and arrived at Messina on 5 Aug. 1914, where, according to German reports, the officers made their wills and deposited their valuables with the German consul. By some unexplained chance the *Goeben* and *Breslau* eluded the vigilance of the French and British squadrons and managed to reach the Dardanelles, meeting only the British cruiser *Gloucester* off Cape Matapan, which engaged both vessels and inflicted some damage. On arriving at Constantinople both ships were «taken over» by the Turkish government. The *Goeben* was renamed *Sultan Selim* and the *Breslau* received the name of *Midilli*. A train of disastrous events was set in motion by the escape of the two ships and their arrival in Turkish waters: Turkey moved steadily and irresistibly toward war from that moment and any temporary wavering was overcome by the impressive long guns of the *Goeben* — 10 11-inch, 12 5.9-inch and 12 21-pounders. Very rarely in the history of war has a single blunder led to more far-reaching consequences than the Allied failure to prevent the escape of these vessels. It was not till nearly four years after the event that the true story of the *Goeben* and *Breslau* incident became public. In June 1918 Mr. Henry Morgenthau, former United States Ambassador to Turkey, published it in his experiences in Constantinople during the first two and a half years of the war (*The World's Work*, New York). Under their new names both vessels were heard of on various occasions during the war, in Black Sea operations on a small scale. In a naval action fought on 20 Jan. 1918, at the entrance of the Dardanelles with a British squadron, the *Breslau* struck a mine and sank; the *Goeben* shared a similar fate, but was able to re-enter the Straits to Nagara Point, where she was beached. The vessel was subsequently refloated.

GOEPP, gep, **Philip Henry**, American composer, musical critic and author: b. New York, 23 June 1864. After early studies in Germany, he was graduated from Harvard University in 1884, and received the degree of LL.B. from the University of Pennsylvania in 1888. He settled in Philadelphia as a resident lawyer, but soon adopted music as a profession and became widely known not only as an organist and composer but as a musical author, his chief influence upon American art being exerted from the literary side. He furnished especially an important factor in the general advance in orchestral taste in the East by his analytical programs, with their crisp musical essays, now found in evidence at almost every great concert. His published works include 'Annals of Music in Philadelphia' (1896); 'Modern Symphonies' (3 vols., Philadelphia, 3d ed., 1913); 'The Lost Prince,' a fairy opera; 'Lullaby' for violin; numerous songs, anthems, part-songs and several instrumental compositions, notably for piano, organ and orchestra. Consult Elson, L., 'History of American Music' (New York, 2d ed., 1916).

GOESSMAN, gĕs'man, **Charles Anthony**, American chemist: b. Naumburg, Hesse-Cassel, Germany, 13 June 1827; d. Amherst, Mass., 2 Sept. 1910. He was educated at Göttingen, where he was assistant in the chemical laboratory in 1855–57; came to the United States in 1857; in 1857–69 held positions in commercial companies and in 1866–68 was professor of chemistry in the Rensselaer Polytechnic Institute (Troy, N. Y.). In 1869 he became professor of chemistry in the Massachusetts Agricultural State College, Amherst, Mass., in 1882–94 was director of the State agricultural experiment station there. In 1886–87 he was president of the American Chemical Society. He built up a world-wide reputation as an authority on agricultural chemistry.

GOETHALS, gō'thalz, **George Washington**, American army officer and civil engineer: b. Brooklyn, N. Y., 29 June 1858. He was a student of the College of the City of New York in 1873–76 and in 1880 was graduated from the United States Military Academy at West Point. On 12 June 1880 he was appointed second lieutenant of engineers; was promoted first-lieutenant in 1882; captain in 1891 and lieutenant-colonel and chief engineer of the volunteer forces in May 1898. In December of the latter year he quitted the volunteer service and in 1900 became major of the engineering corps. In 1905 he was graduated at the Army War College and in 1915 attained the rank of major-general. He retired on 15 Nov. 1916. He was for several years until 1888 instructor in civil and military engineering at the United States Military Academy. He was in charge of the Mussel Shoals Canal construction on the Tennessee River and served on the Board of Fortifications for Coast and Harbor Defenses. His greatest work, however, was performed as chief engineer of the Panama Canal; in which capacity he served ably from the time of his appointment by President Roosevelt in 1907 to the completion of this great waterway in 1914, when President Wilson appointed him the first civil governor of the Canal Zone. His efficient work on the canal is well known; to it he brought an adequate knowledge of engineering coupled with a complete knowledge of army organization and co-operation. The work of the several departments was soon co-ordinated to the common end. The sanitation, housing and labor problems were organized on an equally efficient basis by able deputies and the work went ahead with such efficiency and smoothness that it has come to be a model for other enterprises of magnitude. The canal was completed almost a year ahead of scheduled time and the soundness of the methods employed have been amply justified by time. General Goethals, after the completion of the canal, was obliged to decline various administrative posts tendered him, but in 1917 he accepted the office of State engineer of New Jersey. From April to July 1917 he was general manager of the Emergency Fleet Corporation. On 18 Dec. 1917 he was appointed acting quartermaster-general of the United States army; became chief of the division of storage and traffic of the General Staff in February 1918 and chief of the division of purchase, storage and traffic in April 1918. He received the degree of LL.D. from the University of Pennsylvania in 1913, and from the University of Princeton in 1915.